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The age of Lego companies and Lego projects requires attention on stakeholder management

Almost in every construction project we are witnessing increasing number of subcontractors, special contractors, chained deliveries and even new kind of services. This originates from EVA – thinking (Economic Value Added) which has produced a phenomenon that is very well-known as "out-sourcing". With this approach companies are putting their attention on their core business and organizing it in a way where all non-core activities are placed outside the company.

We are gradually seeing the ultimate appearances and impacts of this development. Trade liberalization has produced international markets of different construction resources. Labor rental agencies are one important example of new kind of players which are having significant impact on construction with the workers there are providing from low salary countries. As a result most construction projects have transformed into buying-projects where the dominant contractors are purchasing the needed resources and their products from their specific markets.

More generally, the described change is taking place in all lines of businesses and in their projects. It is likely that new kind of project planning and management concepts are needed particularly to cope better with increasingly scattered and disconnected projects and their different stakeholders. The crux of the challenge is various parties and their connectivity to each other. Lego-model may work here where we understand projects, their sub-projects, resources and the stakeholders involved as Lego modules which have standard interfaces and are then connectable to each other.

This issue of Project Perspectives is addressing the field of stakeholder management. All 17 different papers included are opening various viewpoints of importance for stakeholder management and presenting most recent research based findings. Still a lot of undone work and uncompleted challenges remains. Stakeholder management cannot be identified as a managerial discipline with acknowledged principles, methods and tools. The term itself may be known but its knowledge content is less widespread and understood.

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The Changing Role of Stakeholder Involvement in Projects:

The Quest for Better Metrics

As the complexities of projects have grown, so has the need for more accurate and timely information. Executives are discovering that time is no longer a luxury but a serious constraint. We are being pressured to provide executives and members of governance groups with reliable information such that they can make informed decisions in a timely manner.

Harold Kertzner

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The International Institute for Learning (IIL)

Background

From the birth of project management in the early 1960s up to the last decade, stakeholder involvement in projects has been more passive than active. Stakeholders focused heavily on the deliverables at the end of the project. And, if they did get involved at all, it was closer to the end of the project where there were fewer decisions for them to make.

During this time period, stakeholders knew very little about the actual processes used in project management. Everything was end-results oriented. Information provided by the project manager was considered as the Gospel, never questioned, and the stakeholders had no way of validating whether or not this was the right information. When decisions had to be made, it was most often seat-of-the-pants decision making rather than informed decision making based upon meaningful information. Simply stated, stakeholders did not know what information they needed.

Today, stakeholders appear to be much more knowledgeable about project management than in the past. Stakeholder involvement is much more active than passive, and the involvement begins right at the initiation of the project. There are several driving forces which necessitated this change:

- The projects we are working on now are more complex than in the past.
- Complex projects most often have a higher degree of risk associated with them.
- Stakeholders are expected to be and want to be actively involved in certain critical decisions.
- Stakeholder involvement in project risk management requires meaningful information.
- Stakeholders understand the difference between traditional decision making and informed decision making.
- Stakeholders want to participate in the decision regarding what metrics they wish to see in order to monitor project progress.

As stakeholder involvement became more active than passive, project managers soon realized that that the way that they handled stakeholder relations management also had to change. Project managers must now:

- Work closely with all of the stakeholders to understand the requirements of the project rather than relying solely upon the client for requirements definition.
- Work closely with each stakeholder or stakeholder group to understand what metrics they wish to have reported, and how frequently.
- If necessary, the project manager may have to create a separate project management information system for each stakeholder.
- The information system will report status in a dashboard format. There may be a different dashboard for each stakeholder.
- Have a dashboard designer as part of each project team.
- Understand that stakeholders now recognize the importance of informed decision making rather than ordinary decision making based upon guesses.

The Need for Meaningful Information

For years, stakeholders never fully understood metrics. They knew that a metric was a measurement, but they often failed to understand that not

Figure 1. The Metric Management Process

all metrics are equal in importance. Today, we differentiate between metrics and key performance indicators (KPIs). Key performance indicators are those critical metrics that substantiate the health of the project and can be used to predict the future success or failure of the project. Project managers can identify up to 50 metrics on projects but usually somewhere between eight and ten metrics are considered as KPIs. The KPIs are what stakeholders need to see for informed decision making (Kerzner, 2011).

Figure 1 shows the metric management process on a typical project.

The steps that the project manager must perform are as follows:

- Customer requirements: The project manager works with the customer and the stakeholders to understand their requirements. This also includes coming to an agreement on the definition of success. In an ideal situation, all of the stakeholders, the client and the project manager will agree upon the definition of success for that project, and it is possible for the definition of success to change from project to project. There are situations where stakeholder agreements may not be possible and the project manager may have to deal with multiple definitions of success on the same project.
- Establishing targets: Once the definition of success is established, we identify metrics that indicate how we will track that success is taking place. For each metric, we must establish a target. For example, if cost is one of the metrics that we will use to define success, then we could say that if we are within ±5% of the budget, we will consider this as success. Since the definition of a metric is a measurement, we must establish meaningful targets for each metric.
- Selecting measurement techniques: Establishing a success criteria and targets serves no useful purpose unless there are techniques available to perform the actual measurement. Fortunately today there are several measurement techniques available such that we can measure just about anything, including goodwill, reputation, value and image.
- Metric selection: Once we know that the metric can actually be measured, then we officially identify it as a metric for the project. We may end up with 50 or more metrics and some of the metrics may not be shown to the stakeholders.
- Select the KPIs: KPIs are the critical metrics that will be reported to the stakeholders for informed decision making. The criteria that is often used to differentiate a KPI from a metric include, p. 103 in (Kerzner, 2011):
  - Predictive: able to predict the future of this trend
  - Measurable: can be expressed quantitatively
  - Actionable: triggers changes that may be necessary
  - Relevant: the KPI is directly related to the success or failure of the project
  - Automated: reporting minimizes the chance of human error
  - Few in number: only what is necessary
- Stakeholder Dashboard design: Once the KPIs are selected, the next and final step is to design the dashboard(s) for each stakeholder, chapter 5 in (Kerzner, 2011). Since there is only a limited amount of space available on a computer screen, only eight to ten KPIs can be displayed at any one time. This is the reason for keeping the number of KPIs to a minimum if possible. As part of dashboard design, we must consider the colors to be used, the selection of the images, the placement of the images, the easy by which the information can be read and the aesthetic value of the displays.

Commonly Used Stakeholder Metrics and KPIs

In this section of the paper we will show several KPIs that have been used by stakeholders. It should be understood that a given metric may be seen as a KPI by one stakeholder but recognized as just an ordinary metric by another stakeholder. Also, the interchange between metrics and KPIs can vary between projects and over the life cycle phases of a single project.

Figure 2 below shows the assigned versus the planned resources. This lets stakeholders know early on in a project whether or not the project is fully staffed. If the project is not staffed properly, then there could be a significant schedule slippage downstream. It is important to use this metric as early as possible in the project.

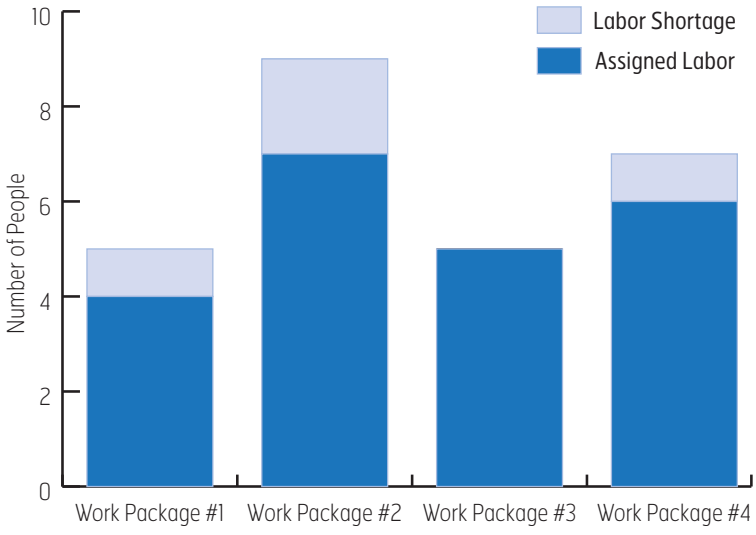

Figure 2. Assigned Versus Planned Resources

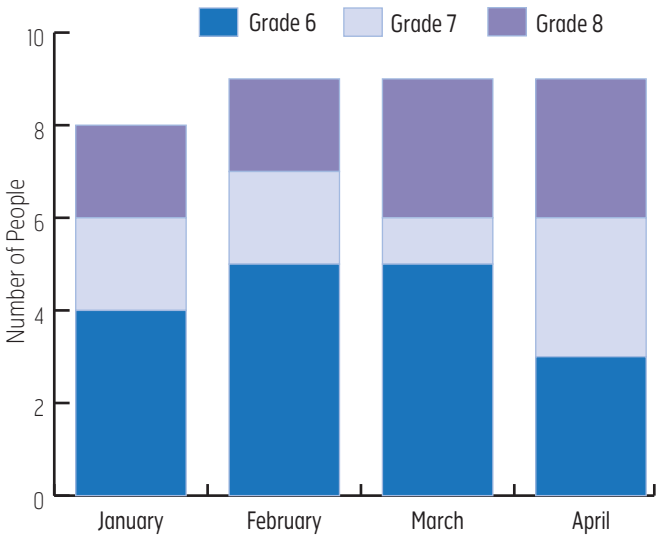

Figure 3. Quality of The Assigned Resources

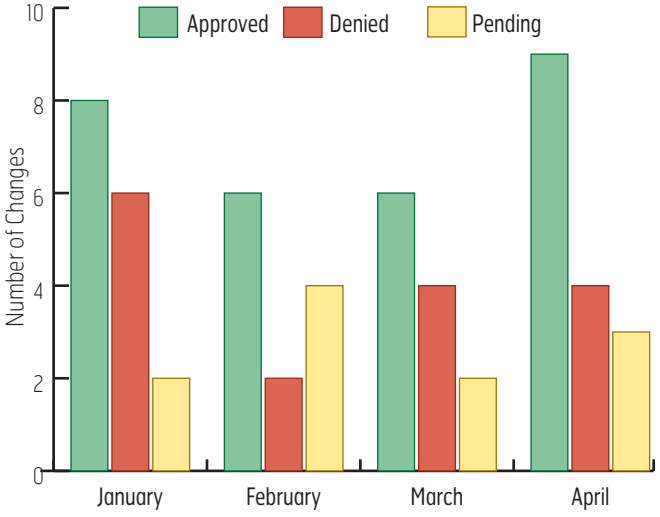

Figure 4. Scope Changes Approved, Denied and Pending

Assigning resources just for the sake of filling a position on a project serves no valid purpose if the people are not qualified to perform the assigned work. In Figure 3, we are looking at the quality, or pay grade, of the assigned resources. As an example, let's assume that the project was estimated based upon Grade 7 and Grade 8 employees being assigned. In January, February and March, at least half of the employees are Grade 6 workers (i.e. Grade 6 is less qualified than a Grade 7). This could be an indication that we are heading for a schedule slippage.

Very few projects are completed without scope changes occurring. Some scope changes are small whereas other may have a significant impact on the budget and schedule. Projects that are large and complex may have people assigned to the project team primarily to manage the scope changes.

Not all stakeholders are actively involved in the approval of scope changes. This is one of the reasons why metrics on scope changes may not appear on each stakeholder's dashboard. Some stakeholders are interested in all of the information on scope changes whereas others only wish to be involved if there is an impact on the final deliverables.

Figure 4 shows the number of scope changes that have been approved, denied or are pending. Scope changes that are pending usually imply that the change control board that approves the scope changes is waiting for additional information.

Most scope changes lead to baseline revisions. Therefore, some stakeholders find it necessary to track the number of baseline revisions. This is shown in Figure 5. A large number of baseline revisions, whether it is the cost, schedule, or scope baseline, are usually an indication that the requirements were not fully developed or understood.

Another metric that is often of interest to some stakeholders is the way that action items are handled. This is shown in Figure 6. Action items that remain open for more than two or three months may reflect poorly upon the project manager and the team members. Too many open action items may indicate that project communication is poor, the wrong people are assigned to the project or that stakeholder governance is not being performed correctly or in a timely manner.

As project management has grown, so has the need for more sophisticated metrics for stakeholders. One such metric, as shown in Figure 7, is the project complexity factor. In this metric, project complexity is rated according to technical complexity, business complexity and delivery complexity.

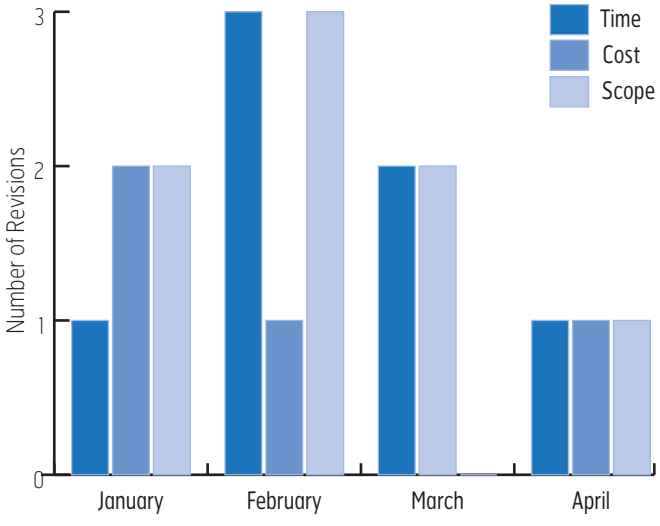

Figure 5. Number of Baseline Revisions

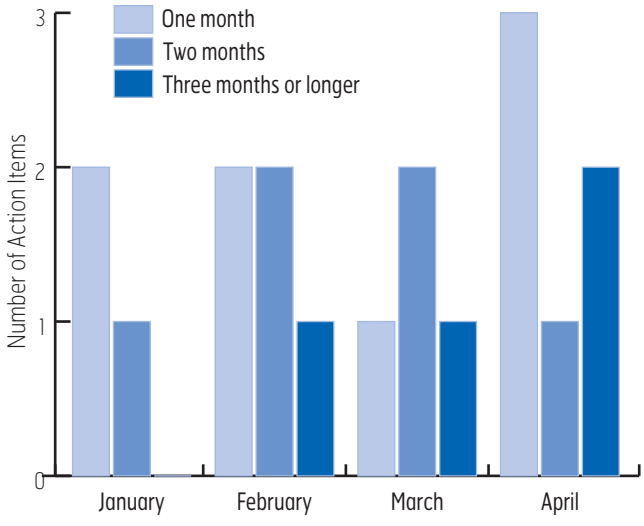

Figure 6. Open Action Items

In January, when the project first began, the technical and business complexities both were assigned a value of 5, which meant very high complexity. Delivery was assigned a value of 4. Therefore, the total complexity was 14 out of a maximum value of 15.

In April, the business and delivery complexity each have a value of 2 and the technical complexity has a value of 3. This gives us a total complexity value in April of 7 compared to a value of 14 in January. In other words, as we get further into the project, the complexity value appears to be lessening. The problem would be if the value were increasing over the duration of the project rather than decreasing.

Some metrics are easy to understand and others may be more difficult. It may be necessary for the project manager to train stakeholders in the use of certain metrics.

Some of the more commonly used stakeholder metrics include:

- Percent of work packages adhering to the schedule
- Percent of work packages adhering to the budget
- Number of assigned resources versus planned resources
- Percent of actual versus planned baselines completed to date
- Percent of actual versus planned best practices used
- Project complexity factor
- Customer satisfaction ratings
- Number of critical assumptions made
- Percent of critical assumptions that have changed
- Number of cost revisions
- Number of schedule revisions
- Number of scope change review meetings
- Number of critical constraints
- Percent of work packages with a critical risk designation
- Net operating margins

The near term future seems pretty clear; stakeholders are becoming more knowledgeable in project management and want to make informed decisions. For this to happen, we must learn better ways of providing real time information to stakeholders, such as through dashboards, and we must provide them with meaningful metrics.

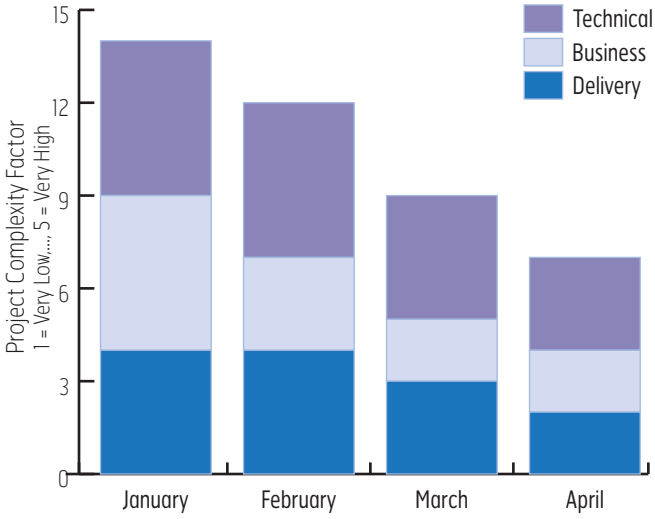

Figure 7. Project Complexity Factor

Conclusions

The future appears to be metric-driven project management. Project managers will take courses in metrics management. Each project team will have dashboard designers that can prepare real time dashboards for stakeholders. Paperless project management may very well be in our near term future.

References

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Project-Based Metrics, KPIs and Dashboards, John Wiley & Sons and The International Institute for Learning Co-publishers, 2011. The International Institute for Learning also conducts webinar and seminars on Metrics, KPIs and Dashboards.

For additional information on the book and the seminars/webinars, please contact: Inna Halminen, Managing Director, IIL Finland, World Trade Center Helsinki, Aleksanterinkatu 17, 00100 Helsinki. Phone: +358 9 278 3210; fax: + 358 9 278 3211; mob. + 358 (0) 40 775 2880
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The Northeast Ohio Chapter of the Project Management Institute has initiated the **Kerzner Award** granted yearly to a company or individual that has demonstrated excellence in Project Management. The International Institute for Learning has initiated the **Kerzner International Project Manager of the Year Award** announced yearly for one project manager worldwide that has demonstrated excellence in project management. The project Management Institute, in conjunction with the International Institute for Learning, awards four scholarships each year under the name of the **Harold Kerzner Scholarship Fund**. The University of Illinois has granted Dr. Kerzner a Distinguished Recent Alumnus Award for his contributions to the field of Project Management. Also, Utah State University presented Dr. Kerzner with the 1998 Distinguished Service Award for his contributions to Project Management.

Project Managers's Understanding of Stakeholders's Satisfaction

Studies indicate project success should be viewed from the different perspectives of the individual stakeholders. Project managers are owner's agents. In order to allow early corrective actions to take place in case a project is diverted from plan, to accurately report perceived success of the stakeholders by project managers is essential, though there has been little systematic research in this area. The aim of this paper is to report the findings of an empirical study that compares the level of agreement between project managers and key stakeholders on a list of project performance indicators. A telephone survey involving 18 complex project managers and various key project stakeholder groups was conducted in this study. Krippendorff's Kappa alpha reliability test was used to assess the agreement level between project managers and stakeholders. While the overall agreement level between project manager and stakeholders is medium, results have also identified 12 performance indicators that have significant level of agreement between project managers and stakeholders.

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Introduction

Much research has been done on seeking the best project success measurements (for example: Müller and Turner, 2007, Turner, 2009, Jacobson and Choi, 2008, Yu et al., 2005, Andersen et al., 2006, Kang and Moe, 2008, Müller, 2003, Pinto and Slevin, 1988, Atkinson, 1999, Bryde, 2005, Turner et al., 2008, Anton de Wit, 1988). These studies all recognise the importance of considering key stakeholders' perceptions of project success. However, in reality, the project manager is often the one who reports the perceived success of these stakeholders (See for example Ipsilandis, Samaras and Mplanas, 2008). Hence from a practical perspective, this study asks the question: how accurately can project managers report the perceived success of the key stakeholder groups? However, there has been little to no systematic research in this area.

We conducted an exploratory study that investigated the level of agreement on project performance indicators between 18 project managers and associated key stakeholders. The project manager reported perceptions of success factors for seven different project stakeholder groups, including owner, consumers, operators, project executive, lead contractors, other contractors and public stakeholders. A telephone survey was conducted with 18 project managers and the data was analysed using Krippendorff's Kappa alpha reliability test. The following sections detail the theoretical framework, followed by the research method and the results of this study. We provide propositions for further research.

Literature Review

The Importance of Stakeholder Satisfaction – Level 2

Stakeholders are individuals, organizations and groups who are influenced by the project and/or have some power to influence the project. Stakeholders can be internal or external (Cleland, 1986) and include, for example, the owner, consumers, operators, project executive, lead contractors, other contractors and public groups.

The high failure rate of major projects has been attributed to a lack of attention to stakeholders (Legris & Collerette, 206). Negative attitudes of stakeholders towards a project can cause cost overruns and time schedule delays due to conflicts over project design and implementation (Olander & Landin, 2005). Unrealistic stakeholder expectations have also been identified as a major risk on IT projects (Baccarini, Salam, & Love, 2004).

Some stakeholders, such as the owners, consumers, or operators, are the recipients of the project outputs and hence their perceptions of project success are very important. If a stakeholder is not satisfied the project may not be considered a complete success by that stakeholder group and possibly other stakeholder groups as well. Other stakeholders, who may not be the intended recipients of the project output, may also be affected by the project and have the power to influence the project, including for example external public stakeholder groups. Indeed, stakeholders who are affected by the project will react to alter the design and implementation of the project in

ways that are more consistent with their interests (Boonstra, 2006). This could include stakeholder groups who might try to have the project limited or cancelled altogether. Mitchell's stakeholder salience framework proposes that the claims of stakeholders who have greater power, legitimacy and urgency will be given priority (Mitchell, Agle & Wood, 1997). Hence considerable project management effort is devoted to managing stakeholders (Petter; & Randolph 2009), which begins with identifying stakeholders, determining what they want and predicting what they will do, which will be based upon their perceptions of the project. A large part of this process is based upon the Project Manager's understanding of the Stakeholders' perceptions of the project success as it relates to the stakeholder group.

Difficulties of Project Managers' Understanding of Stakeholder Satisfaction – Level 2

To manage stakeholders' expectations Project Managers need to be aware of the perceptions their stakeholders hold with respect to the project but this may not be easy.

First, the PM needs to know what criteria are important to each stakeholder groups. Not all stakeholders are interested in the same project success criteria. For example, Bryde and Robinson (2005) found that contractors put more emphasis on minimizing project cost and duration, while clients put more focus on meeting stakeholder needs. In addition, stakeholder analysis approaches are difficult to implement due to a lack of clarity regarding how to identify stakeholders and determine their importance and how to identify stakeholders' expectations. Finally, based upon Mitchell's model of stakeholder salience, Project Managers will have better understanding of Stakeholders' perceived project success, where the topic is of high salience. But this begs the question of whether Project Managers know what criteria Stakeholders consider to be salient.

Research Method

Much debate concerned the identification of suitable measures of project success in the project management domain (Müller and Turner, 2007, Shenhar and Dvir, 2007, Turner and Müller, 2005, Turner and Müller, 2006). After all, the ultimate goal in project management is to be successful. As both Turner (2009) and Shenhar and Wideman (2002) point out, the success of a project is judged by different stakeholders against difference criteria. Thus one objective of this study is to identify leading performance indicators, which can be measured by the project team during project delivery to forecast as assessed by key stakeholders. The hope is the leading performance indicators will act as alarm bells to show if a project is diverting from plan so early corrective action can be taken. Further information including methodology and findings of the main research study can be found in Remington, Zolin and Turner (2009) and Turner, Zolin and Remington (2009).

This paper reports the initial findings captured from a survey undertaken with a public organisation in the defence industry. The survey took place in late 2009 over a two months period. The study objective is to examine the level of agreement between project managers and project stakeholders in project success factors. Critical stakeholder groups include project managers, owners/sponsors, consumers, operators/end users, project executives, lead contractors, other contractors/suppliers, and public stakeholders (Turner et al., 2009). Definition of each project stakeholder is summarised in Table 1.

Stakeholder Group	Definition
1. Owners/Sponsors	Are people or group who pays for the project
2. Consumers	Are people or group who buy the product and obtain the benefit from the project's outcomes
3. Operators/End Users	Are people who will use the product and/or services the project is developing
4. Project Executives	Are senior managers from the owner or sponsor organisation
5. Lead Contractors	Are people who design/manage the project
6. Other Contractors/ Suppliers	Are people who provide goods/materials/ works/services used by the project
7. Public Stakeholders	Are people who concern about the project or product environmental, social or economical impacts; such as the media

Table 1. Definitions of project stakeholders

The project success model used in the survey was developed based on existing project success and failure instruments including (Müller and Turner, 2007, Turner, 2009, Jacobson and Choi, 2008, Yu et al., 2005, Andersen et al., 2006, Kang and Moe, 2008, Müller, 2003, Pinto and Slevin, 1988, Atkinson, 1999, Bryde, 2005, Turner et al., 2008). Questions relating to stakeholder satisfaction with relevant project success and failure factors were asked.

A telephone survey was carried out with 18 project managers nominated by the defence organisation who were working in existing complex projects at the time of study. Project managers were asked for their opinion about how the other stakeholders would rate various success factors and indicators on a five-point Likert scale (1 = to no extent and 5 = to great extent). The project managers' answers were then compared with the responses from the stakeholders to indicate the extent to which project managers are in touch with the perceptions of project success held by the various stakeholder groups. Seventy-nine representatives from the stakeholder groups participated in the survey. An example of the measurements used in the survey is shown in Table 2.

In order to examine the agreement levels between project manager and stakeholder groups, an inter-rater reliability test was carried out using Kappa and Krippendorff's Alpha (Krippendorff, 2004b, Lombard et al., 2002, Hayes and Krippendorff, 2007). Kappa and Krippendorff's Alpha is appropriate for interrater reliability calculations because project managers and project stakehold-

To what extent do you think the project's sponsor/owner believe that your project currently…
Measurement of Success
Has clear specifications?
Has a clear purpose?
Has an accepted purpose?
Has appropriate program at the high level?
Has appropriate project plan?
Has open communication?
Has stakeholder endorsement?
Has interested investors/owners?
Has appropriate project specifications? (they are satisfied with them)
Has effective communication pathways?
Has efficient decision-making processes?
Has a good relationship with the prime contractor?
Has a useful prototype?
Has good performance?
Has achieved earned value targets consistently?
Has met appropriate net project execution costs?
Has met environmental standards in project execution?
Has met safety standards in project execution?
Has a good relationship with the project owners?
Has consistently met safety standards in operation in the past 6 months?

Table 2. Project success factors – sponsor/owner perspectives

ers are asked to give their perceptions on items that are given to them. Krippendorff's α is a generalisation of several reliability indices and is well regarded (Lombard et al., 2003). Its flexibility allows its application on data with any number of measures, ordinal measurement and does not require a minimum sample size (Krippendorff, 2007), which is particularly suitable for this study.

Potential benefits of this research include the benefit to academic and the project management community in understanding the perceived level of project success/failure factors from complex project manager community and stakeholder groups. Also, there are practical benefits to policy development in improving the way project success are assessed by project manager and stakeholders.

Alpha	Interpretation	
0.700 – 0.799	Significant agreement	*Appropriate in exploratory studies*
0.800 – 0.899	Considerable agreement	*Mostly acceptable*
0.900 – 1.000	Strong agreement	*Nearly always acceptable*

Table 3. Interpreting the value of Krippendorff's Alpha

Results

Krippendorff's Kappa alpha reliability estimates (see Table 4) were calculated using the SPSS software and a macro provided by Hayes and Krippendorff (2007). Table 3 interprets the significance of the Krippendorff's α value derived from Krippendorff (2004a) and Lombard et al. (2003).

According to Table 4, twelve items have the Krippendorff's α value over 0.700, indicating significant agreement between the respondents for those 12 success measurements. Krippendorff's α is known to be more conservative (Lombard et al., 2003). A tentative conclusion that can be drawn from the results in Table 4, there is significant agreements on some measurements between project managers and project stakeholders. Moreover, there is particularly strong agreement level between project management and other contractors.

We found significant understanding by Project Managers on some measures of project success with Owners, Consumers, Project Executives, Lead or Prime Contractor, Other Contractors and the Public. The Project Managers agree on the largest number of items with Other Contractors.

Project Manager correctly evaluated Owners' perceptions on three very important items:

1. Good Performance (See Table 4: Alpha =.7637, Significant agreement)
2. Met environmental standards in project execution (See Table 4: Alpha =.8255, Considerable agreement)
3. Met safety standards in project execution (See Table 4: Alpha =.7601, Significant agreement)

Project Managers agreed with Consumers that they had received the project consumers' acceptance (See Table 4: Alpha =.7258, Significant agreement). This too is a very important success factor.

With the Project Executives, project managers agreed on four important risk issues including:

1. Good risk awareness(See Table 4: Alpha =.7070, Significant agreement))
2. Managed risk appropriately(See Table 4: Alpha =.8648, Considerable agreement)
3. Consistently met safety standards in operation in the past 6 months (See Table 4: Alpha =.7576, Significant agreement))
4. Met safety standard in project execution (See Table 4: Alpha =.6882, Barely Significant agreement))

With the Lead or Prime Contractor, the Project Managers understood two very important aspects of project success:

1. Allowed the lead contractor to obtain a reasonable profit (See Table 4: Alpha =.8355, Considerable agreement)
2. Demonstrated contract compliance consistently (See Table 4: Alpha =.6717, Barely Significant agreement)).

Finally, Project Managers correctly evaluated Other Contractors' perceptions on a large number of issues:

1. Good relationship with the prime contractor (See Table 4: Alpha =.8673, Considerable agreement)
2. Clear specifications (See Table 4: Alpha =.8157)
3. Trusted the other contractors(See Table 4: Alpha =.7282, Significant agreement)

	Alpha	LL 95%CI	UL 95%CI	Units	Observers	Pairs
Owner						
Good Performance	0.7637	0.6102	0.8929	14	2	14
Met environmental standards in project execution	0.8255	0.6286	1	12	2	12
Met safety standards in project execution	0.7601	0.6017	0.9009	13	2	13
Consumer						
Received the project consumer's acceptance	0.7258	0.4381	0.9254	14	2	14
Project Executives						
Good risk awareness	0.7070	0.3988	0.9773	14	2	14
Managed risk appropriately	0.8648	0.6830	0.9755	14	2	14
Consistently met safety standards in operation in the past 6 months	0.7576	0.5744	0.9168	10	2	10
Met safety standard in project execution*	0.6882	0.4459	0.8941	12	2	12
Lead/Prime Contractor						
Allowed the lead contractor to obtain a reasonable profit	0.8355	0.6529	0.982	7	2	7
Demonstrated contract compliance consistently*	0.6717	0.4917	0.8359	9	2	9
Other Contractors						
Good relationship with the prime contractor	0.8673	0.7551	0.9795	10	2	10
Clear specifications	0.8157	0.6662	0.9456	10	2	10
Trusted the other contractors	0.7282	0.5481	0.8891	10	2	10
Collaborations with other contractors	0.8754	0.7 375	0.9809	10	2	10
Allowed the other contractors to obtain a reasonable profit	0.9605	0.8815	1	7	2	7
Helps the other contractors to achieve their appropriate business goals*	0.6621	0.3428	0.9083	10	2	10
Public						
Met environmental standards in project execution*	0.6905	0.4258	1	7	2	7

Table 4. Inter-rater reliability test results indicating Krippendorff's Alpha.
Shaded items have an Alpha between .68 and .69

4. Collaborations with other contractors (See Table 4: Alpha =.8754, Considerable agreement)
5. Allowed the other contractors to obtain a reasonable profit (See Table 4: Alpha =.9605, Strong agreement)
6. Helps the other contractors to achieve their appropriate business goals (See Table 4: Alpha =.6905, Barely Significant agreement))

For the Public stakeholder group the project manager was close to a significant level of agreement on "Met environmental standards in project execution" (See Table 4: Alpha =.6905, Barely Significant agreement).

Discussion

Although not all items were correctly evaluated by the Project Managers, the Project Managers appear to understand the someof the most important issues for each stakeholder group.

For the Owner, Project Managers had s significant understanding of their perceptions of performance, environmental and safety standards. For the project Exceutives they had significant or considerable understanding of risk and safety issues. The Project Managers had a considerable or at least barely significant agreement with the Lead or Prime Contractor on profits and contract compliance. With other Contractors agreement was had on the quality of the relationship, specifications, trust, collaboration, profits and business goals.

It appears as though the project managers understand stakeholders perceptions of project success on issues, which are most salient to that stakeholder group, hence we propose:

Proposition 1: There will be higher levels of agreement between Stakeholders perceived project success and the Project Managers understanding of the Stakeholders' perceived project success on issues with higher salience.

Stakeholder groups with home the Project Managers did not share any items of agreement include Consumers, Operators/End Users and Public Stakeholders (only one item was barely significant agreement). Thus it appears as though stakeholder groups with whom the Project Managers are more likely to interact on a daily basis, i.e. Owners, Executive, and Contractors, are those whom they will understand better. Hence we propose:

Proposition 2: The more contact the Project Manager has with a Stakeholder group on a daily basis, the more success factors will have significant levels of agreement.

More research is needed to investigate these propositions. This study is limited due to the small sample size. Data was also collected in only one industry.

Conclusion

We questioned the level of Project Manager's understanding of stakeholders' perceptions of project success. We found that Project Managers can correctly evaluate some aspects of project success for each stakeholder group. More research is needed to determine if Project Managers best understand those issues which are most salient to the Stakeholder Groups and best understand those Stakeholder Groups with whom they have daily contact.

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Re-thinking Stakeholder Management in Construction:

Theory & Research

From its roots in strategic management theory, stakeholder management has been adopted by the construction management academic community and applied as a valid paradigm around which research work has been generated aiming to improve project efficiencies and effectiveness. However, academics have argued that stakeholder management should move away from purely theoretical discussions and engage more with the realities of construction project work. This paper re-appraises the stakeholder management concept for the construction domain by re-thinking some of the fundamental principles and ideals present within the more general stakeholder theory literature. It engages with issues which researchers have arguably failed to acknowledge and calls for a re-evaluation of construction stakeholder management research by presenting a review around four distinctive themes: the moral obligations of engaging with stakeholders against the business and efficiency driven imperatives of construction organisations; the contrast between theoretical abstractions and empirically grounded research; the tensions between theoretical convergence versus calls for multiple and divergent perspectives on stakeholder management and the practicalities of conducting stakeholder management in the construction domain. Such a critical re-appraisal of stakeholder management thinking both generates new lines of enquiry and promises to help inform and shape current and future industry practice.

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Introduction

From its origins and roots in the field of business & strategic management theory (Freeman, 1984), the stakeholder management concept has been embraced by construction management academics as a valid and valuable theoretical paradigm to apply in construction project contexts. Stakeholder management is now considered a key concept for the completion of construction project work (Atkin & Skitmore, 2008). This is evidenced by the number of academic publications generated under the "stakeholder management" banner. These publications range in subject-matter from practical advice papers for stakeholder engagement (Chinyio & Akintoye, 2008), guidelines and methodologies on how best to approach the subject (Fraser & Zhu, 2008), conceptual model exploration (Rowlinson & Cheung, 2008), practical tools for utilisation (Walker et al., 2008) and strategic needs analysis (Smith et al., 2001). Often supported by empirical evidence from case studies (e.g. Olander & Landin, 2008), the stakeholder management concept now embraces issues such as risk and uncertainty reduction on projects, sustainability, ethics and relationship management. In the process, stakeholder management has become almost a touchstone of reference for construction management researchers. However, in order for academic discourse to mature effectively, it is often prudent to reflect and re-consider the applicability (or not) of certain mantras. As Green and Simister state,

"The construction industry has a tendency to adopt the latest management fashion in the hope of finding quick solutions to long term problems. It is the responsibility of the academic community to adopt a more critical stance, and to ensure that new fads are evaluated in the light of established theoretical frameworks." (1999, p.64).

A similarly precautionary note has been voiced by Chinyio & Olomolaiye in a recent book concerning construction stakeholder management,

"Although principles can be adopted across boundaries, construction has its peculiarity, hence the need to evolve principles of construction stakeholder management based on empirical research." (2010, p.8).

This paper re-appraises research in the construction stakeholder management field by re-engaging with some of the fundamental principles and ideals present within the more general stakeholder theory literature. It begins to engage with issues which construction management researchers

have arguably failed to acknowledge or simply presumed or assumed to be true and calls for a re-evaluation of construction stakeholder management research practices and ideas. This is done by presenting a review based around four distinctive themes from the general stakeholder management literature: the moral obligations of engaging with stakeholders against the business and efficiency driven imperatives of construction organisations; the contrast between theoretically orientated abstractions and empirically grounded research in engaging with construction stakeholders; the tensions between theoretical convergence versus calls for multiple, contextualised and divergent perspectives on stakeholder management and the practical implications of conducting stakeholder management in the construction domain. Such a critical re-appraisal of construction stakeholder management thinking both generates new lines of enquiry and promises to help inform and shape current and future industry practice.

Stakeholder management theory

The evolution of the stakeholder management concept is traditionally attributed to Freeman (1984), whose discussions of the idea were firmly rooted in the strategic management and business field. Other scholars since Freeman have further clarified the definition of a stakeholder, so that stakeholders are now commonly viewed as any individuals or groups of persons with a direct interest in a project or enterprise. Carroll provides a succinct definition of stakeholders as,

> *"those groups or individuals with whom the organisation interacts or has interdependencies... any individual or group who can affect or is affected by the actions, decisions, policies, practices or goals of the organisation." (1993, p.62).*

The validity of the stakeholder management concept for business was underlined by Savage et al., (1991), where effective stakeholder management by a "strategic" manager was identified as a way of obtaining corporate effectiveness (and profitability) through analysis of the benefits and threats posed by stakeholders when a course of action was being decided upon. Although stakeholder theory may not give primacy to one stakeholder group over another, in practice, companies are arguably more concerned about efficiencies, effectiveness and profitability, and in such an analysis, the claims of some such stakeholders (e.g. investors) will be more important than others. Partiality (as opposed to impartiality) may be a natural, indeed necessary, characteristic of stakeholder management in order that the competing claims of stakeholders may be effectively assessed and managed (Gibson, 2000).

Academic discourse on stakeholder theory has continued. For example, Friedman & Miles (2002) acknowledged that the complexity of stakeholder and organizational relations makes sweeping theoretical propositions difficult to support. They noted that existing stakeholder management theories often omit to recognise fundamental facts of business life: that pragmatic forces operating in the corporate world which affect stakeholder relations should be recognised and the boundaries between different stakeholders may be blurred and be unstable. Additionally, the dynamics of stakeholder and organizational relations is often over-simplified and stakeholder "types" are seldom distinguished in the literature.

Whilst Jones & Wicks (1999) have proposed convergent stakeholder theory as a fresh theoretical approach, Freeman (1999, p.233) dismissed their convergent stakeholder theory as unsound,

> *"We do not need more theory that converges but more narratives that are divergent – that show us different but useful ways to understand organizations in stakeholder terms."*

Similarly, Trevino & Weaver (1999) have argued against the idea of converging theories together. They called for further empirical research to be done in order to advance the evidential base of stakeholder management theories and to add credence to the stakeholder research tradition. This call for more narratives and empirical research work from the strategic management field chimes well with recent comments from the CME (construction management & engineering) academic community.

Construction stakeholder management

The stakeholder management concept appears to have been widely accepted by the CME academic community as a valid and useful paradigm. A 2008 special issue of Construction Management & Economics was devoted to the subject and publications continue to appear on the subject every year. It is clear from this academic output that stakeholder management is viewed by many as important for construction industry work, as vital as other areas of activity such as briefing, sub-contracting and facilities management. However, the CME literature is littered with many questionable assumptions and curious propositions which are often based upon insecure theoretical foundations. These potential flaws in the subject are perhaps reflected by a distinct lack of unification amongst construction professionals with regards to which strategies, methodologies and processes to adopt with regards to construction stakeholder management.

Stakeholder management is rooted in strategic management theory and this is often evident in the CME literature. In quoting Cleland (2002) for a definition of stakeholder management, Chinyio & Olomolaiye (2010) position themselves firmly within the field of strategic business management theory. Their introductory chapter is littered with quotations from strategic management theory authors which remain unsupported with empirical research evidence from real construction projects. For example, "an organisation may sometimes have to trade-off the needs of one stakeholder against another" (Thompson, 2002); "when the differing expectations of stakeholders cannot be achieved at the same time, compromises become worthwhile" (Johnson et al., 2005) and "as stakes are not static but dynamic, there is a need to manage the constantly shifting balance between the interests of

stakeholders" (Goodijk, 2003). These observations may be valid and difficult to refute, but they come from strategic management scholars and are not supported by any evidence from the construction industry domain. Chinyio & Olomolaiye (2010) also note that not all researchers agree on the importance of stakeholders, and that stakeholder theory itself has been criticized on both theoretical and empirical grounds.

The majority of CME research papers on stakeholder management have chosen to focus on practical aspects of the subject (e.g. tool formulation, advice for project managers, stakeholder identification & categorization) rather than explore underlying theory to justify the stakeholder concept. Whilst the merits of publishing more practical papers for industry consumption is obvious, the danger of not having a strong theoretical foundation could result in papers disjointed from the realities of construction project work. Atkin & Skitmore (2008) have observed that the heated debate between academics over correct definitions and attaining a conceptual consensus on stakeholder management had detracted from more beneficial and useful exploratory work into the concept: their call for further exploratory work reinforces the argument that construction stakeholder management needs a stronger theoretical basis in order to produce practical papers which have more validity.

These initial observations of the CME stakeholder management literature provide a contextual background for reviewing the literature further. It is clear that uniformity and consensus of opinion amongst researchers has yet to be attained: there is no universally accepted way of achieving successful stakeholder management; there is no one method, tool or idea to employ to make it happen; indeed, there may be theoretical problems where construction stakeholder management is concerned. The CME stakeholder management literature may be objectively critiqued by orientating a review around themes identified in the general stakeholder management literature. Using this approach, it is evident that tensions pivot around several themes: the moral obligation of companies to engage with stakeholders against their business and efficiency driven imperatives (Gibson, 2000); the contrast between theoretically orientated abstractions and empirically grounded research in engaging with stakeholders (Friedman & Miles, 2002); the tensions between theoretical convergence versus calls for multiple, contextualized and divergent perspectives on stakeholder management (Freeman, 1999) and the practical implications of conducting stakeholder management (Trevino & Weaver, 1999). The CME literature will now be reviewed using these distinctive themes, highlighting important questions and issues as the discussion progresses.

There is no universally accepted way of achieving successful stakeholder management; there is no one method, tool or idea to employ to make it happen

Moral obligations versus business imperatives

That construction companies have moral and ethical obligations to their stakeholders has been recognised, but both the nature of this moral responsibility and how it translates into actions and corporate behaviour is less well defined. Clearly, when an organisation has power, it has a responsibility to use that power fairly and equitably (i.e. with power comes responsibility, Smyth (2008). But in a construction context, morality and ethical responsibility may be less well defined than in other business sectors. For example, the concept of corporate social responsibility (Crowther, 2008) is very real in the clothing and food retail business (i.e. use of cheap labour; fair-trade coffee; dolphin-friendly tuna, etc.). But do ethical and moral issues drive construction company decisions to a similar extent? Certainly, moral and ethical issues are now theoretically recognised in the sustainability agenda, but the extent to which they drive business decisions (and stakeholder management) is unclear. In reality, are moral obligations judged to be more important than the hard-nosed business imperatives of finishing a project on time, within budget? Indeed, are economic targets themselves ultimately moral and ethical in essence?

In truth, the moral dimension of stakeholder interactions (i.e. that stakeholders both internal and external to a project will have complex ethical perspectives on a project) has too often not been adequately addressed by CME researchers. Smyth (2008) comments that many CME academics have failed to recognise that stakeholders external to a project have more concerns than pure profit and gain from a building enterprise. Similarly, Moodley et al. (2008) rightfully recognise the need to account for stakeholder ethical and moral concerns around construction projects. Both Smyth (2008) and Moodley et al. (2008) propose their own methodologies for engaging with the morality concept, but these ideas are more theoretical than practical because they are not rooted in exhaustive empirical testing. The admission of Moodley et al. (2008, p.630) that, "the values and value system of the matrix owner will determine which ethical issues to include", suggests their matrix may be flawed because the stakeholders themselves are not divulging their ethical and moral concerns about a construction project. However, these works are arguably a positive move towards the creation of more intuitive models of stakeholder assessment. Smyth (2008) himself argues for a move away from approaches underpinned by skewed utility and from self-interested power-based analysis, embodied by such devices as "power/interest-level" matrices: morality-informed assessment methods of stakeholder management would be more sophisticated in this respect. Yet, the difficulty of finding the "moral compass" of any stakeholder is significant: assigning values to such ideas in numerical or graphical terms even more problematic (especially if estimations are done by external parties).

Therefore, whilst the ethical and moral concerns of stakeholders are significant issues, how best to obtain, assess and then act on them is a more difficult subject to grapple with. Understanding and

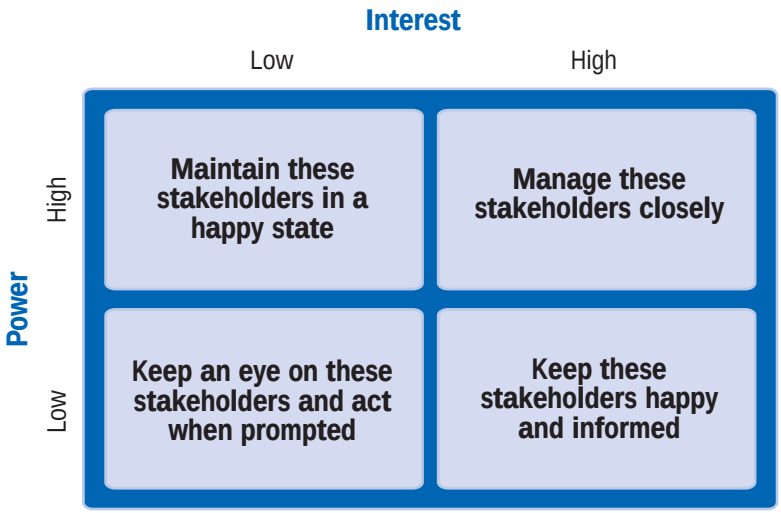

Figure 1. A power-interest matrix.
Source: Chinyio & Olomolaiye (2010: 89)

acknowledging the moral-stance of stakeholders is a not insignificant concept for construction project success, but there are potentially real tensions for construction companies in balancing business imperatives with moral obligations to stakeholders. The CME academic output on stakeholder management has largely failed to engage with how organisations balance their "moral" obligations to stakeholders with their "business" imperatives: in this respect, further research work could attempt to re-dress the imbalance.

Theoretical abstractions & empirically-grounded research

There is a clear demarcation between theoretical abstractions regarding stakeholder management in construction and empirically-grounded research work in the field. It has been noted that stakeholder management originated in strategic management thinking, and that its adoption by the CME academic community has been largely unchallenged. It could be argued that much of the CME stakeholder management literature has little empirical-grounding, being fundamentally theoretical in nature: this is evidenced by academic publications which arguably too easily borrow phrases from the strategic management literature and which argue for the use of tools and methodologies with little empirical foundation.

Newcombe (2003), for example, argued that the concept of the client had been replaced by that of project stakeholders and argued for the importance of stakeholder mapping for project success. He proposed the use of several 4-box matrices to allow the "power", "predictability" and "interest-level" of key project stakeholders to be mapped and surveyed by project managers. Such 4-box grids have appeared regularly in the CME literature (c.f. Newcombe, 2003; Chinyio & Akintoye, 2008; Olander, 2007). A typical example is given in Figure 1.

The mapping of project stakeholders using concepts such as "power", "predictability" and "interest-level" is problematic. Initially, a project manager may be poorly qualified to judge a stakeholder entity in such terms. Such an assessment may be biased, ill-informed and skewed by other events. Additionally, how can such concepts as "power" and "interest-level" be objectively quantified? Is stakeholder "power" their financial muscle, their legal authority or a matter of personality? Concepts of "power" and "interest" in such tools are arguably too simplistic: the nature and manifestation of "power" is unclear; the ethical and motivational influences behind "interest" are unacknowledged and unexplained. Smyth (2008) expressed concern over the use of such devices, stating that there is a serious credibility gap between stakeholder theory and many of the practical methodologies and strategies proposed in the AEC literature. Such tools are skewed towards organizational and project self-interest: creating profit and growth through meeting project objectives. A more fundamental problem with such matrices is a lack of empirical effectiveness: an absence of applied, rigorous testing counts against their effectiveness on real projects. On the few occasions when they have been tested (e.g. the stakeholder impact index of Olander, (2007), they suffer from not being utilized and applied for sustained periods of time. However, in this case, the author notes that further research is needed to examine and evaluate the application of the tool, reinforcing the point that further work often needs to be done in order to strengthen the validity of conceptual models. Such practical questions often arise from research work offering tools for utilization.

Further research is needed to examine and evaluate the application of the tool, reinforcing the point that further work often needs to be done in order to strengthen the validity of conceptual models.

A recurring issue with some of the CME literature is the use of terms or concepts which are difficult to substantiate. The concepts of stakeholder "power", "interest-level" and "predictability" have already been mentioned. Nguyen et al. (2009) list many such concepts as being significant for stakeholder assessment work (*power, legitimacy, urgency, proximity, vested interest, attitude,*

knowledge) and through assignment of numeric values (and calculations via formulae), develop a stakeholder impact analysis based on these concepts. Whilst it is hard to argue against the validity of such concepts, using them practically via numeric valuation techniques raises more difficult questions. Bourne & Weaver (2010) have rightly expressed concern over the use of such concepts because the judgements used to assess them are usually personal in nature (e.g. by a project manager) and therefore, can never be truly objective.

Research work which engages with stakeholders on real construction projects is more valuable than theoretical and conceptual work removed from construction project contexts. Olander & Landin (2008) provide case-study reviews of 2 railway projects from Sweden. The authors present informed insights from the case study investigations and detail techniques and tools used for achieving success whilst presenting the serious negative consequences of poor stakeholder interaction. Such work is arguably more valuable than theoretical works with little validation from industrial application. It is therefore observable from a brief review how the literature can be divided between research papers offering more theoretical abstractions concerning stakeholder management (e.g. the use of woolly conceptual abstractions) and those with a firmer empirical foundation, where case-study evidence supports academic arguments.

Theoretical convergence or divergent & multiple narratives?

The tendency amongst CME academics towards theoretical convergence and simplification is evident when different aspects of construction stakeholder management scholarly work are examined. Dissatisfaction with this research output gives credence to the call for more multiple narratives and divergent perspectives on effective stakeholder management from different construction project contexts (Chinyio & Olomolaiye, 2010). Construction stakeholder identification and categorization is a case in point. Both Leung & Olomolaiye (2010) and Olander & Landin (2008) categorize stakeholders as being either internal (clients; consultants; contractors) or external (external public parties; external private parties) to a project. Academics have also categorized stakeholders in other ways, for example as direct/indirect stakeholders, contracted/non-contracted stakeholders (Smith & Love, 2004) or as supportive, neutral or anti-stakeholders (Chinyio & Akintoye, 2008). Whilst it may be possible to classify or categorize stakeholders in such ways, employing a typology method can be problematic. Chinyio & Olomolaiye (2010) state, "given the several dimensions on which stakeholders can be interpreted, some stakeholders may be members of two or more types." They suggest a "multidimensional plot" to capture the full complexity of stakeholders and their often large number but do not elaborate on how that is to be achieved. In the context of a construction project, more sophisticated and specialized methods of stakeholder identification and categorization may be beneficial: stakeholders are complex entities and categorizing them under broad headings may serve little purpose.

Stakeholders are commonly viewed as a source of risk and uncertainty for projects.

Stakeholders are commonly viewed as a source of risk and uncertainty for projects. Papers such as that of Ward and Chapman (2008), attempt to tackle the risk factor through framework generation: the authors present a project uncertainty management process framework to provide a structure for reviewing approaches to analyse stakeholders and related uncertainty management issues. Similarly, Leung & Olomolaiye (2010) propose that a systematic risk-assessment process be followed, preceded by a categorisation of stakeholders into internal and external groupings. However, the authors provide no case-study evidence to strengthen their argument for the use of these ideas in the real world. These academic explorations would benefit from applied application in different construction project contexts as it is reasonable to assume that different construction projects will possess their own individual risk & uncertainty characteristics. Therefore, attempting to create pan-industry solutions may not be the way forward.

Academics have also combined stakeholder management work with important emerging themes such as sustainability. For example, Rowlinson & Cheung (2008) presented a conceptual stakeholder management model based upon the ideas of empowerment, relationship management and sustainability ideals. They compared study evidence from Hong Kong and Australia to argue their points and look at relationship management, stakeholder management and the empowerment factors evident in their case studies. However, sustainability itself is a complex and difficult concept upon which to attain consensus amongst project participants: the academic community has yet to reach agreement on the optimum method of achieving this in a construction project context. As Mathur et al. (2008, p.605) state,

> *"If it is accepted that sustainable development cannot be defined in an objective manner and value judgements exist, then, by implication, the exact interpretation of sustainable development should be determined in the context of each project, its particular characteristics and stakeholders"*

These reflections suggest that CME research in this field might move away from attempts at theoretical convergence towards more multiple, divergent narratives of what constitutes stakeholder management in different sectors and in different construction project scenarios. For example, little research has been conducted to examine the utility and effectiveness of different stakeholder management methodologies and techniques employed at different stages of a construction project in different project sectors (e.g. health, retail, housing). Divergent narratives such as these (although much more focused) do hold the potential to yield more valuable data than generalist theories. Stakeholder management

is a complex concept and it may often be tempting for scholars to engage in over-simplification and theoretical convergence in order to reach compelling arguments. However, the complexity of stakeholder interactions suggests that further applied research work, which is more divergent and sector specific, needs to take place in order to advance understanding of the issues involved.

Practical implications of conducting stakeholder management in construction domain

The issues, practicalities and potential difficulties of adopting a comprehensive stakeholder management strategy has seldom been explored by researchers in the field. Indeed, the practical implications of using stakeholder management techniques are considerable and should not be dismissed as insignificant. Yet much of the academic literature does not engage with this issue at all: there are frequent assumptions, presumptions and omissions about the subject. For example, effective stakeholder management requires commitment (in time and resources) from an organisation: this fact is seldom acknowledged in the literature. Additionally, there are many assumptions concerning the implementation of stakeholder management. It is commonly assumed that the project manager is best qualified to organise and co-ordinate the stakeholder management work (c.f. Chinyio & Akintoye, 2008; Walker et al., 2008; Newcombe, 2003). However, such an assumption should be challenged. A project manager will have personal ideas regarding stakeholder management and these will affect how the concept is engaged with. Additionally, does the project manager have enough time to perform stakeholder management tasks and are they qualified or experienced enough to do the work? Furthermore, if stakeholder mapping should extend beyond the construction phase of a project (as Chinyio & Olomolaiye (2010) state), who will undertake stakeholder management work once a project manager is no longer on the scene? The role of different construction professions with regards to effective stakeholder management on a project needs further applied investigative work.

The nature of construction projects also needs to be recognised by stakeholder management scholars. Construction today operates in a globalized marketplace with many projects being international collaborative endeavours between companies with different cultural, ethical and moral ideas about how to conduct business. Obtaining consensus amongst project actors on stakeholder management strategies and methodologies to employ may be difficult (if feasible at all). Moodley et al. (2008) highlights the need for obtaining shared global ethical values in a globalized construction environment but an easy answer on how this is to be achieved is elusive. Additionally, the very real business dynamics of construction project work will also affect how stakeholder management is conducted. Macro-economic and business cultural norms, manifested through contracts between construction project actors (e.g. a client & contractor) could be viewed as restrictive and limiting in stakeholder management terms: the drive to finish work on a project as soon as possible within set arbitrary timeframes (with budgetary targets attached) militates against the employment of stakeholder management strategies. How stakeholder management works effectively in the real pressured environment of a construction project has not been investigated at length or in enough detail.

A further salient point is when exactly should stakeholder management work occur? Although Harris (2010) states that using the separate phases of a construction project can assist in stakeholder identification, the applied investigation of stakeholder management across various phases of a construction project has yet to occur. In many respects, the concept is still open to empirical interpretation and the testing of new ideas. For example, an events-led strategy for stakeholder management has yet to be explored. As construction projects may be viewed as consisting of many series of events, some events will have be more significance to stakeholders than others (e.g. the installation of electrical wiring in a room might not be an event of interest to stakeholders, whereas the building of an electrical sub-station to provide extra electrical power might). An actions and events led theory may, therefore, be a valid angle from which to explore stakeholder management work.

The drive to finish work on a project as soon as possible within set arbitrary timeframes (with budgetary targets attached) militates against the employment of stakeholder management strategies.

The very real practical questions of conducting any kind of stakeholder management initiative should be recognised more in the literature: if research work is disjointed from the realities of construction project work then the practicality and validity of employing any stakeholder management initiatives are seriously compromised.

Directions of further research

The construction stakeholder management discipline will only evolve through more focused and robust research work in the field: theories, ideas and propositions removed from the real-world of construction project work lack the robust evidential base required to make them truly valid. There still remains great scope for researchers to undertake insightful and groundbreaking work in this area. For example, Thomson (2011) recently noted how stakeholder perceptions of a "successful" project cannot be easily determined at the beginning of a project endeavour: the implication being that managing stakeholder expectations may currently be executed in a very one-dimensional way (i.e. project success and stakeholder satisfaction being simply a matter of meeting budgetary and temporal targets). Such work reminds us that effective stakeholder management remains critical for construction project success. Stakeholder management also continues to offer a rich vein for further research activity. However, researchers should remain mindful of the limitations of any work undertaken as stakeholder management remains a complex and abstruse subject to engage with.

Conclusions

This paper has highlighted some of the issues of concern surrounding the construction stakeholder management literature. Questions and issues remain over the validity of ideas, theories and propositions, and these have been usefully deconstructed to pivot around several key themes. Firstly, how construction organisations engage with their moral obligations towards stakeholders and how this impacts (or is affected by) their business imperatives is under-investigated. Secondly, the literature is prone to theoretical abstractions which have little empirical grounding in reality. Thirdly, the temptation of scholars towards theoretical convergence and simplification (in order to create all-encompassing conclusions) should be resisted in favour of research work which is more divergent and unique in nature: more valid and valuable insights regarding stakeholder management will result. Finally, the practical implications of conducting stakeholder management in the construction domain should be recognised, researched and debated more. Too often, the very real practical issues of conducting stakeholder management in a construction project setting have been ignored or omitted from the academic discourse.

Only by maturing as a discipline, will construction stakeholder management thinking become more robust.

Researchers can potentially make the stakeholder management discipline more mature by re-focusing the research lens towards topics and issues that have not been sufficiently tackled by the CME academic community. The stakeholder management concept itself will gain greater credence amongst AEC professionals if it engages more with the realities of construction project work with theoretical abstractions being supported by empirical evidence from the field. More divergent and multiple narratives engaging with the stakeholder management concept will also enhance understanding and clarify the pertinent issues. Only by maturing as a discipline, will construction stakeholder management thinking become more robust. Then findings from the construction industry can inform the stakeholder management discipline itself, the school of thought from which it has emerged.

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Open Prosperity

Project business innovations enabling anybody anywhere to prosper by developing, producing, and selling physical goods

Innovative digitally-driven tools are enabling new types of project businesses that can enable anybody anywhere to develop, produce, and sell physical goods. Rather than just managing a few projects per year, these new types of businesses can facilitate thousands of projects per year. Thus they open up the opportunity for anybody anywhere to create their own prosperity. This paper provides an overview of the new project businesses; and how introducing unified languages of design can further expand their scope of operations.

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Factory 2.0 project businesses

Since before the Industrial Revolution there have been two dominant trends in the development and production of physical goods. First, there has been a continual raising of financial and professional barriers against the participation of individual consumers. Second, there has been a trend towards the mass production of physical goods. Today, brand holders only allow individual consumers to choose from ranges of pre-designed of products and/or assemblies. In other words, individual customers get choice - but they do not get authority. Even with user-centred innovation where individuals can offer product ideas / designs, authority over design and production remains with design and production experts who are employed by brand holders.

Until now only a few types of physical goods have not been taken into mass production. This is because they are specific in form, function and/or finish to a particular customer, location and/or event. Depending on the relative extent of craft skill or engineering practise involved, the design and production of such goods may be called bespoke (e.g. jewellery and clothing) or engineering-to-order (e.g. buildings and ships). In either case, effective project management is essential to business success. This is because the development and production of each physical good is a temporary endeavour which is undertaken to meet particular objectives. Thus, businesses that offer bespoke or engineer-to-order services for the design and production of goods are project businesses.

Their established operations are often complicated because they involve products that can comprise many components and interfaces. In addition their established operations are unpredictable because individual customers can have authority over product design and production. As a result, project manufacturing businesses cannot predict the geometry of products nor the components that will be used in products. Rather, they have to wait to find out what each individual customer wants. Accordingly, specifications are unpredictable. By contrast, manufacturers of mass custom products, such as cars, know the geometry of their products and components options for their products before any orders are received. Further, project manufacturing business often involves several projects being carried out at the same time: with each manufacturing project being in a different phase. Resources are shared across projects in interactions that involve multiple parallel and sequential project activities.

The scheduling of activities has to be changed in response to the changing priorities of individual customers. All together, complicated, unpredictable and changing activities result in project manufacturing businesses being characterized by dynamic complexity. This often leads to problems such as defects and delays. Moreover, the dynamic complexity in traditional project manufacturing makes business expansion very difficult (Fox et al., 2009).

Now, however, two radical new trends are emerging and converging that can enable a fundamental change in the operations of project manufacturing business. First, the read/write functionality of Web 2.0 is being combined with digitally-driven tools for the development and production of physical goods. These digital tools are low cost, but high performance, and include:

computer-aided design (CAD) software; computer numerical controlled (CNC) subtractive manufacturing machines such as lathes, mills, etc.; additive manufacturing machines such as object printers. These "Factory 2.0" digital tools enable individuals' content creation to extend to physical goods. Second, open source micro-electronic devices, such as circuit boards, are being offered that enable individual consumers to include sensors, actuators, etc., into their new physical goods. Thus ordinary individuals can make their own "Internet of Things" (Fox, 2010; Fox 2011).

The convergence of these two new trends is seeing the introduction of new types of businesses that enable anybody to develop, produce and sell sophisticated physical goods. The operations of some of these project businesses are not specific to any particular type of goods. For example, Kickstarter (http://www.kickstarter.com/) enables individuals to quickly find investors for their new product ideas. Similarly, Shapeways (http://www.shapeways.com/) enables individuals to make, and then sell, almost any kind of product or part. By contrast, other Factory 2.0 project businesses have a more specialised focus. These include: the Physical Design Company that specializes in light weight buildings (http://www.physicaldesignco.com/); and Local Motors that specializes in cars (http://www.local-motors.com/). The key characteristics of Factory 2.0 are summarized in Table 1 below, under the headings of its core processes: ideation, propagation, creation.

Overall, Factory 2.0 project businesses reverse two trends that have dominated since before the Industrial Revolution. First, they radically reduce financial and professional barriers against the participation of ordinary individuals. Second, they cut back mass production by enabling individual development, production, and sale of physical goods that spring from the imagination of individual people. Thus, they enable highly distributed development, production, and sale of goods close to point-of-demand. This is much more sustainable than the current centralized industrial paradigms that have evolved in the Developed World since the Industrial Revolution.

Further, Factory 2.0 project businesses extend the advantages that do-it-yourself (DIY) goods and services provide for individual users and for society as a whole. For example: DIY goods and services can enable many people to do what previously only a few people could do; can lower costs of goods and services for individuals and for society; can increase users' authority over when and where activities are carried out; can provide users with increased satisfaction and pride of ownership.

Moreover, Factory 2.0 project businesses show how harnessing the potential of Web 2.0 and digital tools introduces opportunities to go from managing a few projects per year to facilitating hundreds of projects per year. Most importantly, these Factory 2.0 project businesses introduce the possibility of Open Prosperity: that is the possibility for anybody anywhere to create their own prosperity by developing, producing, and selling their own products based on their own ideas. The advantages of Factory 2.0 project businesses are summarized in Table 2 below.

Characteristic	Summary
Ideation	Factory 2.0 businesses are open to enabling anybody anywhere to realize their own individual product ideas
Propagation	Factory 2.0 businesses are open to propagating new product ideas around the world – e.g. in order to attract investors
Creation	Factory 2.0 businesses are open to enabling anybody anywhere to create physical realizations of their own individual product ideas, using digitally-driven internet-enabled tools that can reduce skill requirements and material usage

Table 1. Factory 2.0 business characteristics

Advantage	Summary
Highly distributed operations	Much more sustainable than centralized industrial paradigms that have evolved in Developed World since the Industrial Revolution
Extend the benefits of DIY	Enable many people to do what previously only a few people could do; also provide increased satisfaction and pride of ownership
Expand project business	Project businesses can go from managing a few projects per year to facilitating hundreds of projects per year
Introduce Open Prosperity	Anybody anywhere can create their own prosperity by developing, producing, and selling their own products based on their own ideas

Table 2. Factory 2.0 project businesses' advantages

There are already many cases of individuals with an original product idea using the services of Factory 2.0 project businesses to prosper by rapid development, production, and sales (Anderson, 2011). However, these cases typically involve individuals who have some existing skill in development phase or in production phase. The remainder of this paper comprises two principal sections. First, summaries are provided of research related to reducing skills barriers in development phase, and in production phase. Then, the possibility is described for Factory 2.0 businesses to expand their scope of operations to large scale projects in the Developing World.

Reducing skills barriers through unified languages of design

The designing of a product during the development phase is currently quite dependent upon individuals' skills. Many new CAD tools have very simple user interfaces, for example: Alibre, Blender, and Google SketchUp. Accordingly, lack of prior skills in the use of CAD software is no longer a significant barrier to product design. However, applied design itself is to some extent an innate ability, which some people have more of than other people. Established fields of applied design include industrial design for consumer goods and architectural design for buildings. One method for overcoming the barrier of some people having

Opportunity	Summary
Reduce reliance on innate design skills	Decomposition of existing types of designs reveals how shape vocabularies and spatial relations can be used to create new designs
Reduce reliance on innate production skills	Shape vocabularies and spatial relations can be defined so as to enable ease of manufacture and simplicity of assembly
Increase local participation	The reduction of reliance on existing skills can more participation among local people who are unemployed
Increase local commitment	The more people who are involved in the design and production of what they use, the greater their pride of ownership

Table 3. Opportunities from Unified Languages of Design

limited innate design ability is for Factory 2.0 businesses to facilitate the formulation of languages of design by user communities. Thus, read/write functionality of Web 2.0 can be extended from social authoring of text to social authority of designs for physical products.

Traditionally, languages of design have been developed ad hoc by professional designers through their own individual creativity, for example, when they initiate brand styles. These brand styles depend on recurring use of particular shapes and spatial relations. Examples are the distinct design languages of: Coco Channel clothing; Fiskars tools, Harley Davidson motorcycles, etc. Languages of design allow great creative freedom. For example, there are many different types of Harley Davidson motor cycles. However, due to the company's distinctive language of design, we do not have to see the company's name on one of their motorcycles to know that we are looking at a Harley Davidson. Similarly, some of the most well-known building architects, such as Alvar Aalto and Frank Lloyd Wright, have clearly recognizable languages of design, which spans the wide range of buildings that they designed.

More recently, research scientist at, for example, Carnegie Mellon University (e.g. Professor Jonathan Cagan) and Massachusetts Institute of Technology (e.g. Professor Lawrence Sass), have introduced less ad hoc methods for developing languages of design (Fox, 2011). This can include the formulation of shape grammars that comprise a vocabulary of shapes and the definition of spatial relations among those shapes. In particular, shape grammars have been formulated for many different types of physical products including: automobiles, bicycles, buildings, cameras, chairs, coffeemakers, mobile telephones, motorcycles, transmission towers. Shape grammars can have different scopes that enable different product offerings including: partial adaptations of existing product designs; new additions to existing sets of product designs; developing new products within an established brand identity; developing cross-over products which combine different classes of existing product types; and developing new-to-the-world products

Within a shape grammar, a shape vocabulary is a limited set of shapes, no two of which are the same. One way to formulate a shape vocabulary is through systematic shape decomposition across a sample of products. The shapes of mobile phones, for example, have been decomposed into phone body and phone fascia. The shapes of drink bottles, for example, have been decomposed into cap, upper part, label region, lower part and bottom. The shapes of motor vehicles, for example, have been decomposed into front wheels, rear wheels, front wheel well, rear wheel well, front fender, rear fender, front bumper and so on. Spatial relations within shape grammars include: parallel, perpendicular and intersect.

At the highest level of shape decomposition, spatial relations can be quite obvious. For example, the front wheels of a motor vehicle generally sit within the front wheel wells. When determining spatial relations it is important to distinguish between those that need to be tightly constrained and those that can be loosely constrained. For example, some shapes of a product can have exact spatial relations to ensure that a generated product shape conforms to brand style, government regulations, etc. These most constrained shapes will have specified parametric relations to other shapes. By contrast, other spatial relations can be more loosely defined to enable the generation of product design that are novel while conforming to brand style, government regulations, etc.

The skills involved in production can also comprise innate abilities to some extent, and some people can have more of those innate abilities than other people. One method for overcoming the barrier of some people having limited innate production skills is for Factory 2.0 businesses to facilitate the formulation of unified languages of design by user communities. Unified languages of design being those that unite production with design from the outset (Fox, 2011).

For example, in order to enable optimum production of unique designs, shape grammars have been formulated which relate to a range of production processes including: fuse deposition modelling; laser cutting, plasma cutting and water-jet cutting; sheet notching, bending and punching and stereo-lithography. To enable optimal production and reduce production skill requirements, shape grammars can be congruent with the properties of materials and the functionality of machines. For example, many board materials are supplied in flat sheets with a limited number of standard stock sizes. Machines for milling sheet materials often have flat beds and have, so-called, two and a half D milling paths (i.e. 2D plus thickness). Accordingly, if board materials are to be used in production, shape grammars can be congruent with their properties (e.g. standard stock sizes) and associated machining techniques (e.g. flat bed milling).

With regard to the assembly of manufactured components, shape grammars can enable designs to be produced in different sizes using different types of equipment – from the same file. First, this offers the possibility of production of a scale model for the purpose of learning how to put the components together into the designed product.

Second, full-sized components can then be produced for assembly into a completed product. Also, the components produced can have accurate friction-fit/snap-fit joints. Thus, the need for prior skill knowledge of assembly work is greatly reduced. A summary of the opportunities from unified languages of design is provided in Table 3. As discussed in the following section, unified languages of design offer the opportunity for Factory 2.0 project businesses to address major challenges in international development projects.

Factory 2.0 businesses for large projects in the Developing World

As more and more of the Developing World comes online, there are more and more opportunities to introduce Factory 2.0 project businesses there. This is not least because of absence of existing industrial infrastructure. Consider, for example, the statement of the president of Rwanda: In Africa, we have missed both the agricultural and industrial revolutions, and we are determined to take full advantage of the digital revolution (quoted in Kircher-Allen, 2009). The absence of existing industrial infrastructure enables Developing Countries to skip the unsustainable centralised industrial paradigms that have evolved in the Developed World since the Industrial Revolution. This is similar to Developing Countries going straight to mobile telecommunications and mobile banking; thus skipping over the fixed infrastructures that have evolved in the Developed World.

In particular, Factory 2.0 businesses that can overcome dependency on existing design and production skills can address the enduring problem of international development projects failing to involve local people in, for example, the design and production of hospitals and schools. This can lead to situations where largely unemployed local populations see foreigners doing work in their countries. This can result in the local populations not caring about what projects are intended to bring to their communities. For example, local populations may even disassemble completed projects so they can take possession of source materials (Dichter, 2003).

In late 2006, Jeff Bezos, the CEO of Amazon, said: "Before long, 'user-generated content' won't refer only to media, but to just about anything. This is because setting up a company that designs, makes and globally sells physical products could become almost as easy as starting a blog – and the repercussions would be almost earthshaking" (quoted in Maney, 2006). Extending the advantages of Factory 2.0 project businesses will be truly earthshaking when they open up the potential for local unskilled unemployed populations to design, make, use, and/or sell the physical buildings and goods that they need to prosper.

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Partnering paradoxes

A case of constructing inter-organisational collaborations in infrastructure projects

The positive nature of partnering to resolve adversarial relationships in the construction industry has been well-rehearsed. However, critics argued that espoused benefits of partnering have not materialised because business-as-usual prevails. Furthermore, scholars have insisted that more needs to be done to analyse emerging practices in inter-organisational collaborations. This study examines an emerging collaboration. Basically, the research sought to investigate effective knowledge sharing during the early stages of a real-life collaborative venture between three infrastructure companies. The case study was informed by participant observations and interviews with key people involved in forming the collaborative venture. Findings reveal a number of paradoxes that are perplexing on the one hand, yet generative in terms of actions on the other. These paradoxes relate to the three areas of sensemaking, formality and time synchronicity.

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Introduction

Calls for reform of the construction industry have become, certainly in the Western world, a regular feature since the post-WWII era (see Murray and Langford, 2003). Such restructuring consistently points towards the need to move away from adversarial working relationships towards developing more effective forms of collaboration, encapsulated in the contemporary agenda of partnering (e.g. Latham, 1994; and Egan, 1998). Advocates of partnering have often claimed that effective collaboration reaps benefits of improved productivity, waste reduction and better client satisfaction (see e.g. Loraine, 1993; Bennett and Jayes, 1998; Construction Industry Institute, 1998; Black et al., 2000; Proverbs et al., 2000; Naoum, 2003; and Wood and Ellis, 2005). At the same time, partnering promises the possibilities of bridging the age-old gap between the key social actors (i.e. clients, designers and contractors), as well as integrating ever more complex supply chains, in construction (see e.g. Latham, 1994; Egan, 1998; Akintoye et al., 2000; Vrijhoef and Koskela, 2000; and Saad et al., 2002).

Despite the somewhat intuitive claims of how the wonders of partnering can help arrest the problems associated with fragmented relations in construction, there are still gaps in understanding how inter-organisational collaboration in construction really works (see e.g. Wood and Ellis, 2005; Bresnen, 2007; Gadde and Dubois, 2010; and Bresnen, 2010). Critical scholars have highlighted how the realities of partnering practices are often detached from rhetorical claims of its positive nature (see e.g. Bresnen and Marshall, 2001; and Nyström, 2008); some question whether partnering really can deliver benefits for all (e.g. Green, 1999; and Dainty et al., 2001), whilst others argue that the status quo of adversarial working relationships persists (e.g. Briscoe and Dainty, 2005). There is greater acknowledgement of the limits of prescriptive notions of partnering (e.g. Beach et al., 2005; Phua, 2006; and Chan et al., 2006), and growing acceptance that partnering in construction is simply elusive (e.g. Bresnen, 2009).

Admittedly, supporters and critics of partnering in construction share one common feature. That is, the arguments rallied for and against the use of partnering have implicitly focussed on the essence of partnering (i.e. *being*), and rarely examined the process of how partnering comes into being (i.e. *becoming*). So, on the one hand, partnering is treated as a desired concept fiercely defended by its proponents, such that explaining the prerequisites, components and performative goals (see Nyström, 2005) appears to be their central mission. On the other hand, opponents tended to emphasise the failure of advocates to prove the existence of partnering arrangements and associated benefits in construction, so as to question the validity of the concept and its use. Both camps have thus taken the concept of 'partnering' for granted, and neglected a deeper understanding of how collaborative practices emerge to become 'partnering' as we know it in these debates.

In order to understand how collaboration can be a good thing for all involved, there is a requirement to shift the perspective of partnering in construction away from an essentialist view to one that is based on the *ontology of becoming* (see Chia, 1995). As Cousins (2002) assert, partnerships do not exist, and certainly not as cosy constructs! According to him, it is critical to refocus on the process of partnerships rather than its static, idealised form. Indeed, as Bresnen and Marshall (2001; 2010) argue, there is still a lot of scope to study the emerging practices of partnering in construction to understand how the process of partnering

becomes accepted and applied in reality.

This article draws on the analysis of participant observations in a single case study. The study sought to make sense of emerging practices (see Bresnen, 2009) entailed in the formation of a new partnership through participant observations, primarily to better understand the processes of how partnerships come about. Through the observations, the dynamics of a number of paradoxes (see Bresnen, 2007 for a conceptual review of partnering paradoxes) have been detected in the ensuing collaboration. These paradoxes are manifest in three critical areas – the paradox of sensemaking, the paradox of formality, and the paradox of time synchronicity – that are particular to project partnering, which will be elaborated as the article unfolds.

Arguably, the early stages of forming collaborations are fraught with paradoxes and contradictions (see e.g. Smith and Berg, 1987); yet, the study of such paradoxes in the context of project partnering has hitherto been given relatively scant attention. Thus, the contribution of the present article is two-fold. Firstly, the study reported in this article adopts a practice-based approach to explain the process of early formation of partnering in a single ethnographic case study. In so doing, a number of paradoxes have been identified, and their manifestations observed. And so, the second contribution of this article is an analysis of the dynamics these paradoxes, which would help shed light on how tackling these paradoxes might go some way in affording better collaborations in practice. Following this introduction, the observational context and method will be outlined, before the key findings are discussed.

Case Study Observations: Context and method

This case study arose out of the involvement of one of us – the last author – who was working as a project management support officer to a railway company known as RailCo1. RailCo1 is a local client organisation, governed as a quasi-public sector organisation, with a long history of providing railway infrastructure in London. As a client organisation, it is responsible for providing capacity enhancement to the railway infrastructure managed under its authority, which includes upgrading of existing stations. At the time of the research (between March and November 2009), an opportunity emerged that permitted her to engage in ethnographic research. She was involved in a project to build a new station facility (named as the 'Project'). This facility was to be constructed by RailCo3, a newly set-up railway client, also governed as a quasi-public sector organisation, charged with building new railway infrastructure in London.

However, the 'Project' meant that infrastructure owned by RailCo2, a national railway client wholly owned and regulated by the government that is responsible for the ownership of the national railway infrastructure, had to be relocated to another part of the station. The relocated part of the station is to be built and owned by RailCo2 and operated by RailCo3.To complicate matters further, the relocated facility would then become adjacent to infrastructure owned by RailCo1, which in turn restricted RailCo1's ability to implement its strategy to enhance capacity. Concomitantly, RailCo1 had within the previous 12 months of the commencement of this research completed a long process of subsuming a loss-making public-private-partnership responsible for upgrading stations within its network boundary.

To coordinate the project across the three companies, it was decided that an integrated project team (named here as RailPro) involving members from each company was set up. This decision was also driven by senior officials at the governing authority of Greater London as a way to rationalise resources. One senior representative from each of the three companies – each were accountable to the board of directors of their respective companies – also formed a Liaison Group (named here as RailLG) to facilitate strategic discussions around the formation of RailPro. As discussed above, it is critical to study how the process of partnering comes into being, especially in the context of the early phase of a project. Hence, this case study presented a unique opportunity to get rich and deep insights into the formation of a new partnership that happened during the early stage (i.e. concept design stage) of the 'Project'.

A combination of data sources was used for this research, including interviews with key participants involved in the 'Project' and 'RailPro' (see Table 1 below), observational data, and documentary evidence. The research questions informing

Interviewee	Role	Organisation
A	Senior project manager (operational)	RailCo1
B	Sponsor and representative on RailLG (strategic)	RailCo1
C	Project management support (operational)	RailCo1
D	Sponsor and representative on RailLG (strategic)	RailCo2
E	Project engineer (operational)	RailCo2
F	Sponsor and representative on RailLG (strategic)	RailCo3
G	Building services engineer (operational)	These were design consultants involved in delivering the concept design for the 'project'.
H	Design lead for architecture (operational)	
J	Design lead for engineering (operational)	

Table 1. Profile of project participants interviewed for the research.

the data collection were initially concerned with identifying critical issues, enablers and barriers that contribute to effective knowledge sharing at the outset of the 'Project'. So interview questions included the role of the participant and their perspectives of notable events encountered in the 'Project'. Observations were recorded in the researcher's diary to make sense of the (visible and audible) social dynamics of participants during meetings and review workshops at the concept design stage of the 'Project'. Where appropriate, cross-references were made to minutes of meetings. The interviews were recorded and transcribed for analysis. The findings will be discussed in the next section, including the detour made during the research to focus on emerging paradoxes that surfaced in the formation of the partnership RailPro.

Resources were not only being shared, but rationalised as well since there were clearly duplicity in terms of roles and responsibilities.

Key findings

As mentioned in the preceding section, the initial inquiry sought to explain knowledge sharing behaviours of participants in this case study. The motivation came from previous *"show stopping"* experiences between the three RailCos in when undertaking site acquisitions and negotiations on land use. There was then an observed absence of effective knowledge sharing within and across each of the three companies, which led to the pursuit of this research project in the first instance. At the start of this research, high-level meetings that occurred at the RailLG level and 'Project' review meetings were concerned with two key issues, namely geographic and systematic integration of operations across the three RailCos into the formation of RailPro.

Questions were raised about the possibility of co-location of staff and setting up of operating procedures for RailPro. Put simply, the procedural form and scope of the partnership were being developed (Loraine, 1993). It was also clear to the participant observer and interviewees that the formation of RailPro meant that resources were not only being shared, but rationalised as well since there were clearly duplicity in terms of roles and responsibilities (and there were redundancies that actually took place soon after the research). Given this backdrop (and the history of difficult working relations in the past), participants had expected that the sharing of information would not be forthcoming. Surprisingly, this was not what the researcher observed at the initial stages of the formation of RailPro. Participants exceeded expectations in that they appeared to be very keen about sharing the information they had about the 'Project'. The observations also yielded another interesting finding; that is, as procedures were increasingly formalised, the openness observed at the outset of the research started to dwindle. This led us to take a detour to explore the dynamics of this paradox, explained in terms of sensemaking, formality, and time synchronicity.

Paradox of sensemaking

It is widely known that as projects progress in time, participants travel from a phase of relative uncertainty towards producing outcomes that are more certain. Therefore, sensemaking (Weick, 1995) plays a significant role in this process. Admittedly, the need for participants across the three companies to make sense of what this 'Project' was about and what setting up RailPro means for their work accounted for the relative openness observed in the initial stage of the research. Yet, this was not simply a cosy, emergent process. Rather, the keenness shown in terms of sharing information about their thoughts of the 'Project' was a means to assert one's authority in framing the scope of what the 'Project' was seeking to do. As Participant A suggests, when people were introduced to RailPro from each of the three companies, some still needed persuading as to why RailPro was necessary. He added that they clearly *"had their own objectives and goals"* to articulate. In some respects, the sharing of their perspectives of what the foundations of the cooperation should look like is more of a *sensegiving* (see Gioia and Chittipeddi, 1991), rather than a *sensemaking*, process.

Thus, as Cousins (2002) aptly pointed out, the process of forming partnerships is often rooted in a hard-nosed reality than many Utopian enthusiasts would believe. As the shape of the collaboration takes a more structured form, participants tend to shift their positions to make statements like *"this is not how we would do things in [our respective companies]"*, indicating dissatisfaction with how the partnership arrangements are being articulated, and creating an impression of *sense-hiding* (see Maitlis and Lawrence, 2007) instead.

Paradox of formality

Proponents of partnering in construction place much emphasis on formal tools and procedures. Yet, when RailPro was first conceived, participants at both strategic and operational levels were 'doing' collaboration designing the 'Project'. Formal contracts were only signed and agreed between the design consultants (Participants G, H and J) and RailCo1. Yet, discussions were observed to continue fairly openly between the consultants and members of RailCo2 and RailCo3 as well. It would seem that delivering the 'Project' mattered more than the formal rights and responsibilities articulated in the contract document, even though the 'Project' – at least for RailPro – was still being reified (see Hodgson and Cicmil, 2006). Contracts have been known to invoke communicative acts and social interactions in projects (e.g. Marshall, 2006; and Bresnen and Harty, 2010). It would seem that the absence of contracts also have the power to stimulate, in this case, information sharing between participants, as a typical comment suggests that the *"lack of contractual arrangements did make for more openness"*. Paradoxically, for Participant E, the finalising of contracts did pro-

hibit him from *"getting pally"* with some of the other participants, and he stressed that *"informal arrangements definitely broke down the barriers normally found in communications between the two organisations"*.

Paradox of time synchronicity

Time is an important dimension in projects. Yet, the partnering literature has rather ignored this critical aspect. In prescribing often-linear stages of the partnering life cycle, time is often treated as synchronous, and that partners necessarily know where and when they fit in within such a framework. Moreover, partnering in project-based environments normally downplays the idea that members have shared histories and futures. This is certainly not the case here, where Participant E observed that members do recollect *"their experiences and know whether they hold knowledge that is of use"*. Typically, the construction industry is known to be *"an incestuous industry"*.

Therefore, as seen in the formation of partnership in RailPro, members have come into this arrangement with some sense of a shared history. Yet, as Participant A pointed out, not all the members are willing and able to go along with this arrangement. Participant A remarked, *"it was tricky to do what was best for the 'Project' and still protect the interests of respective companies"*. This would suggest that not everyone abided by the 'programme' of this partnership formation. Bresnen (2009) coined the phrase "living the dream" to stress the lived realities of partnering in construction. Perhaps the participants in this case study are *chasing the dream*, burdened with past histories and passing through time, however asynchronously, into a possible shared future? Yet, the notion of time and how it shapes partnering practices, and the paradox of time synchronicity, deserves more attention.

Conclusions

"Personalities played a key role in the [partnering] success (Participant A)". At a very basic level, human relations do matter in achieving effective collaborations. But this is not the full picture. This case study research contributes to a more holistic view of how the process of partnering could potentially (and simultaneously) be driven and hampered by a range of paradoxical issues. Yet, paradoxes are rarely examined in detail in the construction management literature. Here, sensemaking, formality and time synchronity have been exposed as paradoxical constructs in the start of a new collaboration, albeit with 'old' partners. These paradoxes raise a perplexing, if interesting, question to advocates of formal and prescriptive tools used in partnering (and in project-based working more generally). How did the absence of formal mechanisms lead to the observation that members were actually 'doing' the collaboration and the 'Project'? Clearly, the station facility was still being designed and planned for construction, despite members being clear where they stood with the relationship between their respective organisations and newly-formed one. Of course, human agency still prevails in this situation, afforded no less by the emergence of these paradoxes.

The members involved have, by living through these paradoxes and chasing the dream of more effective coordination between partners, legitimated the form of partnering that eventually makes sense.

Whilst the contradictions may have disrupted the idea of formal, prescriptive methods, they were also found to be generative in terms of social interactions and dialogue. What is clear from the case study is that conversations and arguments happen as individual agendas become articulated and legitimised. The only certain conclusion is that the members involved have, by living through these paradoxes and chasing the dream of more effective coordination between partners, legitimated the form of partnering that eventually makes sense (see Oliver, 1997; and Vaara and Monin, 2009). Such narratives gained through ethnographic research are therefore required to explore fully the process of how partnering comes into being. Whether the outcomes are positive or negative (or even coherent with the intended strategy) does not matter so much!

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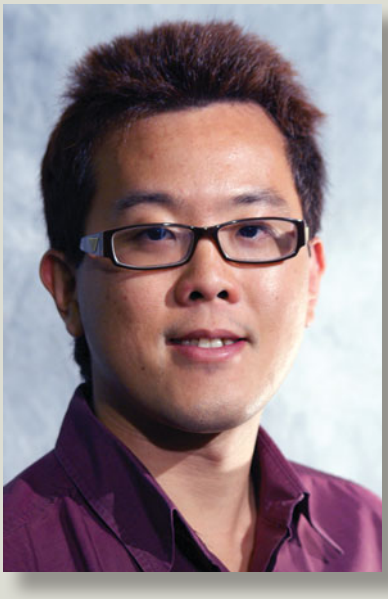

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Opportunities of open innovation environments for large infrastructure projects –

NETLIPSE case study

Technological and organizational excellence is the key element for business success in any modern business and project environment. Post globalization and instable business environments demand permanent improvements and changes of business processes. “Open the boxes” and exchange information, ideas and set-up collaboration with stakeholders such as customers, end-users, clients, vendors, business partners, potential competitors – this is a challenge of current (project-) organizations and their innovative environments. The open innovation environment concept was born in 2003, presented by professor Chesbrough from Berkley. Since then, researchers and practitioners are searching for successful applications of this idea. How we can improve the performance of large infrastructure projects by using this concept of work will be presented in this paper. The theoretical introduction will be illustrated by practical example of the existing NETLIPSE knowledge network. NETLIPSE is the network for dissemination of knowledge on the management and organization of large infrastructure projects in Europe.

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Beyond Organizational Excellence

Globalization of businesses and fast development of ever more useful and user-friendly, modern information and telecommunications technology enables creation of business integration and participation of partners from different parts of the world. Emerging new innovative business models better serve customers and business partners’ satisfaction needs. They alter the economic order; we witnessed a large global cultural change. National borders will become increasingly less obstacle in business and other organizations.

We see that the competencies required for a fair global business environment are very different from those typical of the industrial era in the 20th century. Unfortunately, they are still encountered in practice in most companies and project organizations today. The product value creation process was driven by suppliers in the industrial age (Figure 1). Significant for the industrial culture was the absence of customers’ inclusion in product development processes. The most important issue for this phase is ability to produce quality and competitive products. Many

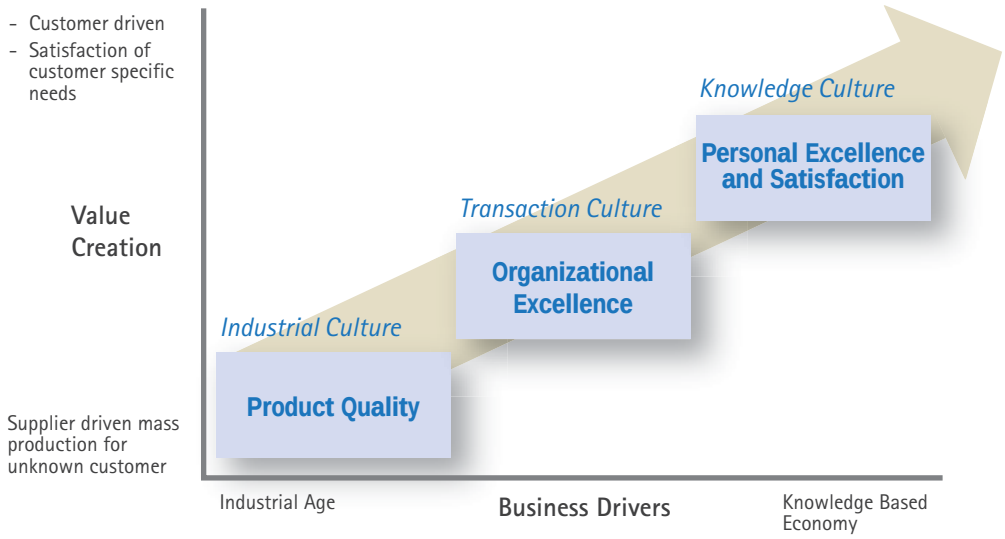

Figure 1. Value migration of business drivers (Semolic 2009)

This is an updated and edited version of a paper that was first time published in the proceedings of IPMA 2010 World Congress.

modern organizations are in the development phase of the transaction culture. The main characteristic of this phase is creation of wealth by business transactions. Organizational excellence is one of the main drivers in this stage which has been present in last twenty years. The business excellence is in search of organizational excellence, where extrinsic organizational rewards are often still more important than real intrinsic personal satisfaction of all organization's stakeholders. Nowadays when we are entering the knowledge based economy, real intrinsic personal satisfaction becomes one of critical success factors of global competitiveness. Inclusion, collaboration, co-creation, customer satisfaction and "win-win" approaches are the main characteristics of this phase and organizational culture. The key factors in this development stage are the people involved. Competent and highly motivated people (internal and external) can provide results which reach beyond owners, managers or client expectations. This can be reached by utilization of personal excellence and satisfaction of all involved parties.

In this post globalized world, organizations are facing constant competition from both regional and the global markets; demanding to increase their pace to innovate, produce and provide at higher quality with a higher degree of customizability of their products and services. In order to secure sustainable competitiveness, the leading organizations have recognised the need to shift from classic organizational structures to being more diverse and distributed internally as well as externally, mainly depending on collaboration as a basis for competitive advantage in innovation (Mertins 2003, Firestone 2002, Tapscott 1999). For organizations, this change is driven by directed and sustainable collaboration with their complementing entities holding relevant knowledge. This concept of work is supported by the idea of an open innovation environment (Chesbrough, 2003) which says that nowadays organizations needs to collaborate with their business partners and all other relevant stakeholders, to secure permanent inflow of new information, ideas and proposals to support the internal innovation processes.

For this reason supporting the right position of knowledge, information sources and their interaction to optimize the collective view of all the stakeholders is of key importance. The bigger impact of such a structure could be foreseen in the virtual associations that are mostly objective and are based on knowledge resources (Byrne 1993, Pettigrew 2003). Thus far these professional associations are mostly conceptualized in theory as knowledge workspaces that are established based on similar knowledge focuses, facilitating from professional clusters to expert groups. In practice the virtual professional platforms have proven short-lived and one of the main reasons identified is the lack of sustainable and scalable governance mechanisms.

That fact changes and produces new forms of economic and non-economic activities, whose main features are increasing responsiveness to customer requirements - users, increasing responsiveness and flexibility of business units, increasing labor flexibility, the ability to quickly respond to changes in global markets, capacity building and project team working. It is a process of changing values, which are crystallized into the formation of a new organizational post globalized culture. Values that will increasingly be, are associated with improving the level of responsiveness to customer requirements-user on the global market changes, the degree of innovation, the rise in the inter-organizational collaboration culture and inter-personal cooperation, co-creation and creativity.

Type of Knowledge Worker	Characteristics
Mono Culture	Problem solver expert without participation of other experts
Bilateral Culture	Problem solver expert with participation of his professional colleague
Star Culture	Problem solver expert with participation of his professional colleagues from different professional disciplines
Networking Culture	Co-creation of problem solution by participation of different knowledge workers and stakeholders

Table 1. Knowledge workers typology (Semolic 2009)

Open innovation systems and collaborative business environment

Knowledge workers are people who are selling their knowledge based services to employee or on the open market. Peter Drucker was the first expert who introduced the term "knowledge worker" in his book, Landmarks of Tomorrow (1959). He believed that knowledge work productivity will be one of the biggest challenges in years to come.

The knowledge workers are the "corner stone" of knowledge based economy. The complex and technology high demanded business environment needs experts who are capable to provide prime class solutions of complex problems. This cannot be done by one expert only. It shall be done collaboratively with participation of other experts (knowledge workers) that provide different needed expertise. The trends on the global market show that we are moving towards agile- collaborative workplaces. The "Agile Workplace" was recommended by Gartner in 2001 (Palot et al, 2005). In this report they say that agile workplaces were representing the next important step in workplace evolution and the alignment of space and work was considered innovative, if not radical, only a decade ago but then became a mainstream practice. The main characteristics of an agile workplace are know-how, specialization, collaboration, co-creation, openness and project based work.

Formally presented main characteristics of knowledge worker:

KW (T, C, M)

Where are:
KW – Knowledge Worker
T - Talent
C – Competences
M - Motivation

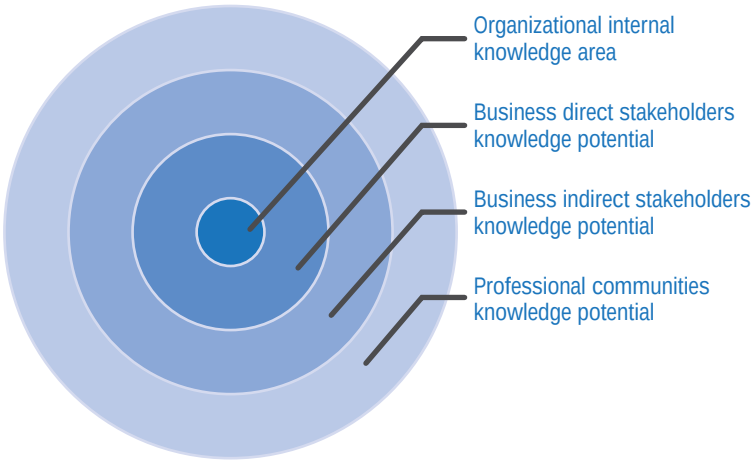

Figure 2. Areas of organizations' knowledge potential (Semolic 2009)

Nowadays environment needs knowledge workers who are willing to collaborate with experts and stakeholders from different professional disciplines, organizations and environments. The list of different collaborative types of knowledge workers is presented in Table 1.

We can find knowledge workers in any, small, medium or big sized organizations, as well as in profit or non-profit organizations. Beside this, knowledge workers can make their businesses as independent experts, so called "freelancers". The trends show that we will have more and more freelanced knowledge workers, who will be on the list of organizations' collaborators deployed by temporary-project based engagements.

Comparison between traditional and new organizational values shows trends of value migration from the "organization-centric" to "knowledge – centric" business environment. Beside this traditional company is focused on the worker's personal productivity, while the new economy company is focused more on "interpersonal productivity" and supports a new knowledge generation by using internal and external resources. For this purpose the knowledge workers are motivating to organize, facilitate or participate in different collaborative virtual communities. The Figure 2 shows the areas of organizations' internal and external knowledge potential.

To be successful we need to create new business ecosystems which will enable and motivate this kind of interpersonal productivity. The new economy entrepreneurs need to be capable of creating synergetic based innovative business models which will integrate strategic envisioning of their organizations, performance of innovative supporting systems by engagement of talented and competent people under the leadership of competent leaders.

The described concepts of work we are illustrating by the practical example of the NETLIPSE Network initiative. The NETLIPSE Network focuses on increasing and dissemination knowledge on the management and organization of large infrastructure projects (LIPs) in Europe. These projects include high speed railway lines, highways, waterways and tunnels. The main goal of this program is to create and develop an open innovation environment, where main LIPs stakeholders such as client organizations (ministries, local governments), infrastructure research and knowledge institutes and projects themselves, from different European countries can exchange their knowledge, experiences, best practices and collaboratively search for the best models and improvements of existing business designs in order to improve the level of project management at this level.

The NETLIPSE Network was co-financed by the EU FP6-FP7 fund from 2006 – 2008, and is now funded as part of the TEN-T Executive Agency Annual Program.

The Case Study of the NETLIPSE Collaborative Network

An efficiently delivered and operated European transport network is essential if the European Union is to ensure their economic and sustainable competitiveness. The TEN-T is the European Union's Transport Infrastructure Framework. Initially adopted in 1990, it now includes Priority Projects on 30 international axes plus wider transport projects. These projects are targeted to improve the economic efficiency of the European transport system and provide direct benefits to the European citizens. The priority projects, mostly rail and inland waterway schemes, will help contribute to creating a more sustainable transport system and help fight against climate change. In May 2008, Vice-President of the European Commission, Mr. Jacques Barrot, presented the first progress report to the Informal Transport Council on the implementation of the TEN-T priority projects. In it, he praises the Member States and Community Institutions in their efforts to accelerate the delivery of the priority projects. Project delivery and effective realisation being a challenge of the past programming period, Barrot also promised to step up efforts in encouraging Member States to not only coordinate their transport policies by exchanging best practices, but also by identifying early obstacles to funding and solving cross border constraints.

The NETLIPSE (NET-work for the dissemination of knowledge on the management and organisation of LIPs in Europe, www.netlipse.eu) network development phases:

PHASE 1: Initial research phase (2006-08) financed by 6th EU Framework Programme (research of 15 LIP business cases),

PHASE 2: NETLIPSE network development phase (2008-10):
- Development of LIP Assessment Tool (IPAT) and
- NETLIPSE community expansion and development,

PHASE 3: Global expansion, collaborative research, development of new products and services (2011 -....)

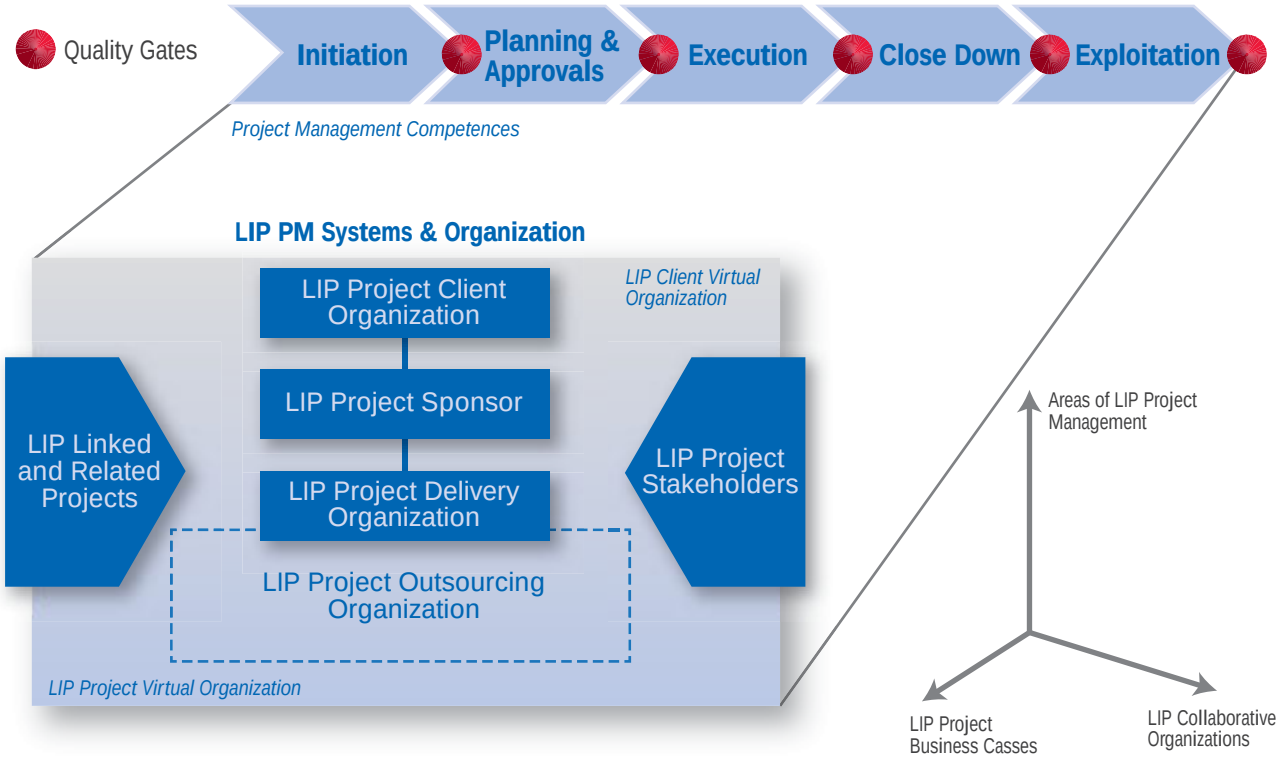

Figure 3. Working environment of NETLIPSE open collaborative network

From 2006-2008 the NETLIPSE project, a project in the Sixth Framework Programme, focussed on gathering best practices and lessons learnt in the management and organisation of large infrastructure projects (LIPs) in Europe. 15 LIPs were researched by regional knowledge teams, consisting of experts in the field of project management (representatives from the scientific, project management and client organisations). The Figure 3 illustrates working environment of NETLIPSE open collaborative network.

The first NETLIPSE project presented main findings and an overall vision of how to manage, evaluate, monitor and benchmark LIPs in April 2008. In addition to carrying out the research, the project consisted of setting up an active network for the continuous and interactive knowledge exchange in this field in order to develop the expertise of all parties involved. Dissemination tools were developed to support this continual knowledge exchange, such as a knowledge database with project information, network meetings and site visits to present and discuss results as well as a website (open and closed sections for Special Interest Groups) and a bi-annual newsletter.

In the second phase 2008-2010, the NETLIPSE network has run under the TEN-T Annual Programme and now consists of partners from governmental institutions, knowledge institutes and private organisations from 15 European countries, organisations managing and sponsoring the 15 researched projects and other interested organisations involved in sponsoring and realising LIPs in Europe. At the bi-annual Network Meetings representatives from more European member states have participated. Figure 4 illustrate system and components of NETLIPSE Network governance.

One of the key goals of NETLIPSE Network is to improve the level of project management of these projects on a European level. Next to the development of the Infrastructure Project Assessment Tool (IPAT) for the assessment of projects, the Network has erected Special Interest Groups where knowledge development and dissemination takes place.

The NETLIPSE Special Interest Groups (SIGs) are dedicated to researching, developing and disseminating knowledge based on vast experiences of specific topics in the management and organization of LIPs. Interested members from the network can join or lead a Special Interest Group by organizing or attending group discussions on specific themes, organizing events, presenting at conferences and/or preparing publications, tools etc. Network members can be members of more than one SIG. The SIG is free to decide its own purpose, as long as it corresponds to the overall goal of the NETLIPSE network namely, developing and improving the management and organization of large infrastructure projects in Europe. In the future it is possible that disseminating and developing this knowledge is not solely limited to the European boundaries. For now, this limit is challenging enough.

Each Special Interest Group is coordinated by an Issue Manager. This is an individual who is responsible for keeping the SIG alive and running, i.e. initiating SIG meetings, events and products and finding the topics that will create value for all the SIG members. In order to tackle the chances of being a short lived initiative due to the lack of sustainable and scalable governance mechanisms (as mentioned before), the SIG Issue Manager and its members need to create a value that is recognized by all its members. As of yet, sharing experiences and best practices and carrying out research in teams, has proven very beneficial. As

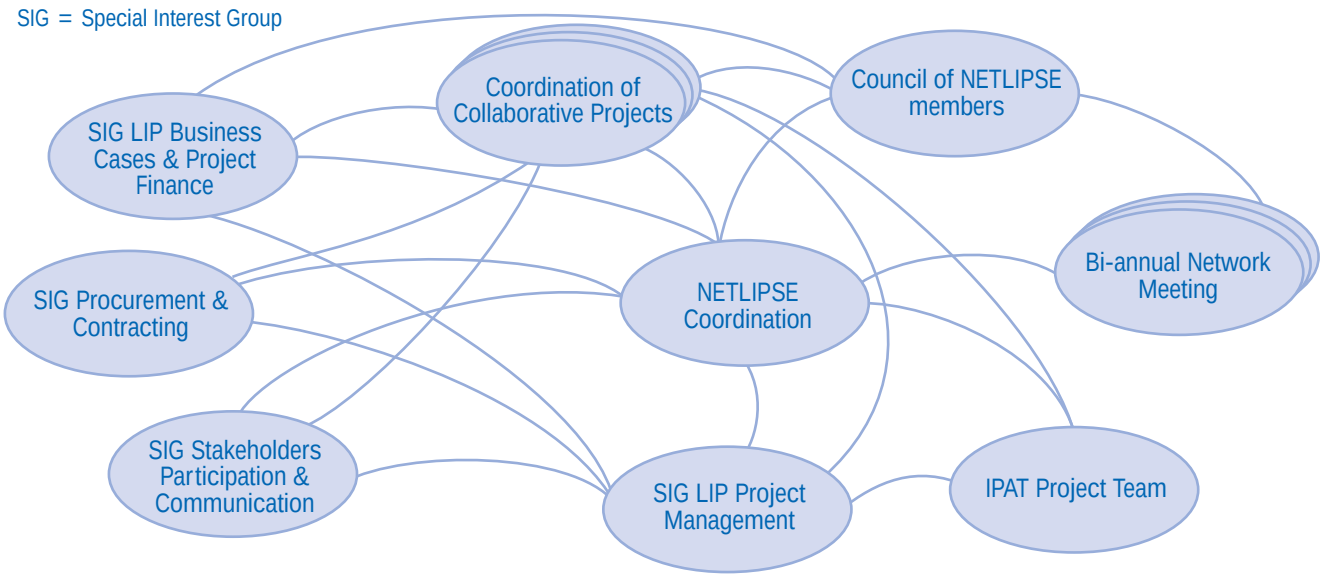

Figure 4. System and components of NETLIPSE governance

one client representative stated: "participating in the SIG meetings and doing a NETLIPSE case study, has been better than any management training whatsoever".

Depending on the needs of the SIG, various supporting communication tools have been developed such as the internet-based virtual environments and dedicated communities on the website. These sections are open to SIG members only and consist of an archive with relevant articles, publications and presentations, contact information of SIG members, etc. The SIGs meet regularly, at least at every Network Meeting which take place twice a year.

The number of SIGs is not limited. If more than two Network members decide it interesting enough to initiate a SIG, they are free to submit a request to the NETLIPSE Board. The Board decides on the feasibility of a SIG, which may have a temporary nature, i.e. for the research or development of a specific topic, or have a more ongoing nature. As of 2011, there are four SIGs up and running:

1 Business Cases
- Dedicated to discussing the challenges of and developing an effective business case in large infrastructure projects to be used as an important tool in the decision-making phases.
- Issue Manager: Matt Dillon, Project Sponsor, Department for Transport, UK.

2 Stakeholder Management & Communication
- Dedicated to discussing the challenges of and developing effective stakeholder management & communication tools and approaches for successful execution of large infrastructure projects operating in an ever-increasing influential environment.
- Issue Manager: Pau Lian Staal, Quality & Organisation Coordinator North/South Metro Line, Netherlands.

3 Contracting & Tendering
- Dedicated to discussing lessons learnt, challenges and developing new insights on effective contracting and tendering strategies for large infrastructure projects.
- Issue Manager: Prof. Konrad Spang, Chair of Projectmanagement, Universität Kassel, Germany.

4 Project Management
- Dedicated to improving the quality of the management and organization of LIPs in Europe.
- Issue Manager: Prof. Brane Semolic, Head of Project & Technology Management Institute University of Maribor, Faculty of Logistics, Slovenia.

The enthusiasm of all NETLIPSE Network members is proven to be the cork that the network floats on. Proof of this is the quality of the discussions that have taken and are taking place, the benefits experienced by the delegates who can translate the experiences of colleagues to their own (national) contexts, the fact that more member states are signing on supporting the network and the increasing number of delegates at general meetings.

Conclusions

In the modern business environment, organizations will establish and maintain their competitiveness not solely by optimizing their own potentials, but more often by being able to use the resources of others and by interconnecting them into an overall process of creating new value. Methods and forms of organizing different modalities of virtual organizations and collaborative platforms are based on innovative flexible business models. The described concepts of work can generate value for every involved organization, profit and non-profit, as we could see from practical example of the NETLIPSE Network. Governmental organizations can reduce capital expenditures and risks, commercial organizations can increase their competences, knowledge centers actively participate on the "knowledge market" and finally LIP's customers' satisfaction level can be improved.

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Decision-making under uncertainty in drug development

In pharmaceutical industry, decision-makers have to decide whether to continue drug development projects, if the tests results on new compounds are good enough. Such decisions are made collectively, under a high degree of uncertainty and in non-emergency situations. These projects are very expensive, risky, and long. The major problem in this context is indecision. In order to improve the decision-making process in practice, we need to characterize and analyze situations of decision-making under uncertainty. In this paper, we propose a new definition of uncertainty that takes human factors in its characterization into account. Then, the factors that contribute to generate, characterize, perceive or process uncertainty are structured in a typology. That helps us recognize and explore causal and influential factors of uncertainty. Additionally, based on interview results, we present a description of the decision-making process in pharmaceutical R&D, illustrating the role of different actors, their interactions, and the flow of information. This should help decision-makers adopt proactive practices instead of reactive ones.

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Introduction

Decision-making in R&D faces much uncertainty in all industries. The development of new products implies dealing with uncertainty that comes from innovation in product development process, market dynamics, and changes in regulation. Many questions need to be answered in order to make decisions during the development project. In pharmaceutical industry, the degree of uncertainty is particularly high, since even if many tests are performed on animals, the behavior of the new compound in human body cannot be known.

A drug development project is defined as a process that allows a presumably active chemical or biological entity to become a pharmaceutical drug. After passing a series of tests, the drug is certified for commercialization, guaranteeing its safety, efficacy, and quality (Gourc & Bougaret 2000). Drug development projects are composed of different phases, separated by Go / No Go decision milestones, wherein a steering committee decides whether to continue or stop the project. These decisions are based on project status information and the results of the studies which are generally very poor compared to what is required to make an informed decision in optimal conditions.

Drug development projects last an average of 13.5 years and cost about $ 873 million, with a success rate of only 4% (Paul et al. 2010). The cause of this high attrition rate is not related to the lack of management of time, costs, and resources. Planning is a crucial, difficult, and necessary task for project success but it is not sufficient. There are unclear zones that we are not able to recognize at an early phase of a project (Perminova et al. 2008). In drug development, the main reason of this high attrition rate is the lack of knowledge about the safety, efficacy, and quality of the molecule during the first phases of the project. In a full 50% of lately stopped projects, failure is due to lack of efficacy, 30% to lack of safety and 20% are not safer nor more effective than the drugs already available on the market (Gordian et al. 2006).

In this context, decision-making process is characterized by: 1) a strong degree of uncertainty: when the profits and risks are unknown, as it is usually the case in drug development projects, the degree of uncertainty is high and the choice is difficult, 2) non-emergency situations: in R&D, decisions to be made do not seem urgent, comparing accident, crisis, and disaster contexts, but a potential danger could arise in the future. Previous research works concentrate on risk and uncertainty in emergency situations, but for the first time, to the best of our knowledge, ours considers non-emergency situations, wherein it is quite possible to postpone the decision, waiting for complete and accurate information. Situations in which decisions may appear without urgency include the choice of investments, renewal and modernization of equipment, and the introduction of new safety devices, 3) the collective aspect: individual differences within a group play a crucial role in interactions between experts and could complicate the decision or indecision processes and engender or increase uncertainty.

The structure of the paper is as follows. First, we review two major approaches to define and identify uncertainty: the objective approach and the subjective approach. We present our definition, which includes both subjective and objective aspects contributing to uncertainty identification. Next, we present a typology of uncertainty factors related to the subject, object and context. Then, we review how decision-making process is defined in the literature and present our description of decision-making process in drug development. Our description is illustrated by a case study based on a real application.

State of the Art

Defining and identifying uncertainty

The most fundamental capability of human beings is conscious decision-making. In order to better understand decision-making process, we need to understand the notion of uncertainty first (Klir 2005). Economists are interested in defining uncertainty in order to identify and control it. In economics, uncertainty is defined either based upon the impossibility of calculating probabilities as in the Knight's definition, wherein uncertainty is defined as a situation in which it is not possible to specify numerical probabilities (Knight 1921), or by emphasizing the lack of information in a more general sense (Galbraith 1973; Thiry 2002; Klir 2005).

Psychologists and sociologists define uncertainty either through a state of mind characterized by "doubt, or a conscious lack of knowledge about the outcome of an event" (Head 1967), or through its consequences: "uncertainty is the inability to act deterministically" (Thompson 1967), "uncertainty is a sense of doubt that blocks or delays action" (Lipshitz & Strauss 1997). In psychology, "in the contrast to the decision theory approach, psychological uncertainty is not a part of the external environment, such uncertainty may be a mental reaction to the external environment, but it is a psychological phenomenon existing only within the mind of the person who doubts" (Head 1967).

In economics, uncertainty is characterized by the lack of information about events and human factors are not taken into account. Thus, in this context, uncertainty is objective and exists independently of the existence of an uncertain subject. In contrast, in psychology, the emphasis is on human's mental state and uncertainty is relative to a subject.

Similar to scholarly definitions of uncertainty, dictionaries often define uncertainty either by emphasizing the object or the subject. For example, the Cambridge dictionary defines uncertainty by emphasizing the object: "when something is not known", whereas Webster focuses on the subject: "the state of being unsure of something". Objective and subjective approaches are also identifiable in philosophers' literature. Aristotle, Descartes and Laplace only admit logic and mathematical rules to construct certainty. Socrates, Plato, Carneades, Pascal and Kant accept other ways of certainty construction such as faith and emotion.

When a subject is uncertain about an object, where does the uncertainty come from? Is it in the subject's mind or does it come from the unpredictability of the object's comportment? We think it is important to take human factors into account in the characterization of uncertainty. In our definition, **uncertainty is a subject's conscious lack of knowledge about an object which is not yet clearly defined, in a context requiring a decision**. Uncertainty cannot be defined neither as only pertaining to the subject nor to the object, because a subject could be uncertain about an object, while another subject is certain about it. Hence, uncertainty is a relationship between subject and object.

Furthermore, context is an important factor in defining uncertainty. A subject could be uncertain about an object but if he does not need to make a decision nor perform an action, this situation is not considered to be an uncertain situation. For example, I am not sure whether the laboratory building is accessible during the weekend or is closed due to construction, but since I do not plan to go there this weekend, this situation does not concern me. This definition of uncertainty includes the three elements that contribute to the identification of uncertainty: subject, object, and context.

Typology of uncertainty factors

Figure 1 outlines the main categories of the factors that contribute to generate, characterize, perceive or process uncertainty. This typology is based on three axes of the uncertainty definition: subject, object, and context: 1) factors of uncertainty related to the subject are divided into two sub groups: the subject's psychological traits and his professional experiences as individual factors and contradictory opinions and debates as collective factors, 2) factors of uncertainty related to the object refer to two sub groups: the states of the object that are dynamic and the goals of the subject that depend on the object's states, 3) factors of uncertainty related to the context also refer to two sub groups: internal factors such as the organizational and hierarchical factors which do not favor the circulation of information inside a company and could increase the level of uncertainty. Likewise, external factors exist such as market dynamics, competitors' activities, stakeholders' expectations, regulatory changes, and doctors' conviction in a new drug, which make the environment of decision uncertain.

The comprehensive vision of this typology helps us understand the sources and the influential factors of uncertainty associated with the manager and the project team (subject), with the project (object), and the environment (context) of the decision. This allows us to control some of the uncertainty sources in order to reduce it as much as possible and deal with what remains according to the type of the source.

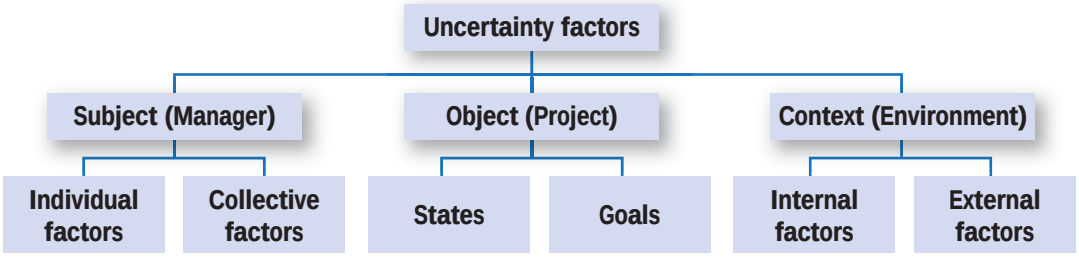

Figure 1. Our typology of uncertainty factors

Decision-making process under uncertainty

Decision-making is an important part of any organization (Panneerselvam 2006). Simon has suggested that "a decision is not an *act*, but a *process*" (Tsoukiàs 2008). The process involves selecting the best among several options through a proper evaluation of the parameters of each option and its consequences (Panneerselvam 2006). However, "all decision is a matter of compromise. The alternative that is finally selected never permits a complete or perfect achievement of objectives, but is merely the best solution that is available under the circumstances" (Simon 1947). Generally, decision is the result of interactions between preferences of individuals. The decision process mainly consists in these interactions, under the various compensating and amplifying effects of the system that make up what we shall call the decision process (Roy 1996).

The decision-maker usually chooses an option based on the balance of benefit / risk of available options. If he knows all the possible options and their consequences, he is in the case of a deterministic decision. For example, in maintenance management, if the annual maintenance cost and the annual operating cost of equipment are known in advance and are not subject to any change in the future, then the decision about the economic life of the equipment is a deterministic decision (Panneerselvam 2006). In the case of non-deterministic or decision under uncertainty, information about different choices and their consequences is partial for the decision-maker. The degree of uncertainty could be different. This difference corresponds to the difference between required information and available information.

A decision-making iterative process in four stages has been proposed by Simon: *Intelligence stage* as the first stage comprises information collecting and problem identifying, *Design stage* centers on an alternative analysis and construction (invent, develop, and analyze), *Choice stage* focuses on alternatives evaluation, and *Review stage* consists of evaluating earlier decisions and satisfaction level (Simon 1977). Janis and Mann propose a vigilant decision-making process which takes into account any new information or expert judgment to support the choice process (Janis & Mann 1977). Based on these two processes, in the next section, we propose a global vision of decision-making under uncertainty in drug development projects. The objective is highlighting the role of different actors and the flow of information.

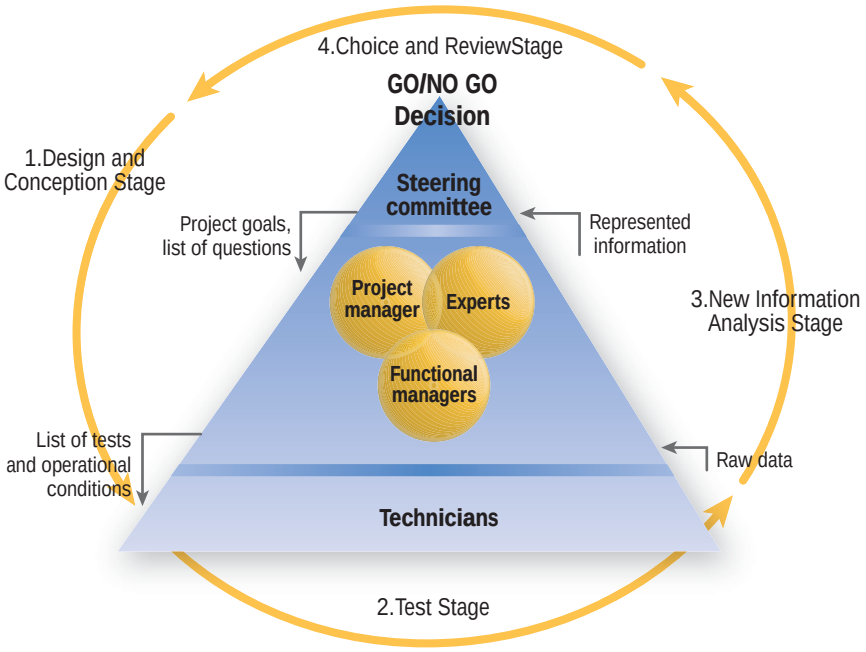

Figure 2. Global vision of decision-making process in drug development projects.

Decision-making process in pharmaceutical R&D

Global vision

Figure 2 represents two dimensions in decision-making process: the actors with their positions in a pyramid form and the flow of information in italic font. We distinguish four macro-stages in the decision-making process: 1) Intelligence and Design stage, 2) Test stage, 3) New Information Analysis stage, and 4) Choice and Review stage. The first stage, which corresponds to Simon's model (Simon 1977), includes problem identification, information collection, and solutions development. The steering committee needs information about molecule activity and behavior in human body, in order to decide whether or not to continue the project. Project goals and a list of questions about the characteristics of the molecule are transmitted to the project team in charge of defining the Target Product Profile (TPP) as a key strategic tool, which guides drug development. TPP is the key design template for creating the development plan and should be defined by the project team as it is a multidisciplinary task (Kennedy 1998). Focusing on the TPP, the project team determines a list of tests and operational conditions for technicians.

The second stage corresponds to the fourth stage of Janis and Mann's model: searching new information relevant to the choice. In this stage, the technicians carry out the tests and provide the raw data (Janis & Mann 1977). The third stage corresponds to the fifth and sixth stages of Janis and Mann's model: "taking account of any new information or expert judgment, even when the information does not support the initial choice of course of action and re-examining the positive and negative consequences of all known alternatives, including those originally regarded as unacceptable, prior to making a choice" (Janis & Mann 1977). In this perspective, the raw data will be interpreted by functional managers. Project managers and experts contextualize the information depending on the project goals and consult functional managers to carry out the new tests, if necessary. Finally, the contextualized result of the tests will be presented to the steering committee. The last stage corresponds to Simon's model during which the steering committee, using a benefit / risk analysis, will decide whether to continue or not.

In the first two stages, the project managers more or less know which questions must be answered in order to obtain the authorization of commercialization (European Commission 2008). However, the hypotheses about the molecule are not yet verified by the tests. Thus the factors related to the object (project, new molecule) play an important role in creating and processing uncertainty. But in the last two stages, we have to interpret, analyze, contextualize, and represent the acquired information and the role of the subjects (project manager and the experts) becomes crucial. A more detailed version is presented in the next section, emphasizing the last two stages.

Detailed vision

Figure 3 illustrate a detailed vision of decision-making in drug development projects. We use the Business Process Modeling Notation (BPMN), which is a standard graphical notation. This diagram illustrates the interactions between the different actors and shows the flow of information from the top to the bottom of the pyramid and vice versa. We focus on the new information analysis stage of the decision-making process.

At the end of each phase, several options exist. If the results of studies are sufficiently good and demonstrate the objectives of the phase such as efficacy for animals in preclinical phase, the decision will be to continue or accelerate the transition to the next phase (tests on humans). If the results are not adequately satisfying, the steering committee, consulting the project team, requests to perform the new tests which clarify and complete the previous results. Depending on the situation, it is possible to postpone the Go / No Go decision waiting for the new results or to start the next phase and review the decision when the new results arrive. If the results are bad and prove the inefficacy or the toxicity of the molecule, the project will be stopped.

During the whole process, we find examples of the three types of uncertainty factors. During the interpretation of data, the factors related to the object (molecule) play an important role in creating uncertainty, especially by incompleteness or contradiction of information. Factors related to subjects, especially individual factors, such as perception and reasoning are also important. During the contextualization of information, factors related to the context appear: internal factors, such as the condition of other projects in the pipeline and external factors such as market dynamics.

During the representation of information, the role of subjects in the communication of results is crucial. At the end, during the Go / No Go decision, factors related to subjects, especially collective factors, such as debates and different ideas about the doubtful results contribute to creating uncertainty. There are two major problems in such a human-in-the-loop system: the loss of information and the subjectivity of interpretation and representation, on the right-hand side of the pyramid. This description helps us obtain an understanding of the decision-making process, which is essential to improve these practices.

Application case

Many questions need to be answered to prove the safety, efficacy, and quality of a molecule in order to obtain the authorization of commercialization. The toxicity of the molecule, its stability, clinical and side effects, mechanism of absorption and distribution in human body, and elimination from it are a few examples of these questions. In the decision pyramid, we consider the stability question as a part of the quality question: is the product stable under conditions of usage? Many environmental factors affect the stability of the product.

Depending on the project goals and also the available quantity of the product, the project team establishes a list of tests to be conducted in order to obtain data on product degradation in different climatic zones. Operational conditions such as temperature, humidity, and light are also determined, so that the real packaging and storage conditions are simulated. A protocol that includes this information and also the study number, quantity of the product, time intervals, measurement, and analysis methods have to be followed by technicians. Table 1 presents a simplified part of the results. At time t_0+12 months, technicians register – 0,05% of degradation in ambient temperature.

The functional manager's interpretation is that our molecule is approximately stable. The project team contextualizes this interpretation in terms of project goals and tries to answer the following questions: does this degradation rate impact the efficacy of the molecule in usage conditions? Could the degradation rate be reduced in another container such as a blister? In relation to the results of other studies, such as toxicity, is this degradation rate acceptable? Thus, after all these tests and studies, many questions remain without certain answers.

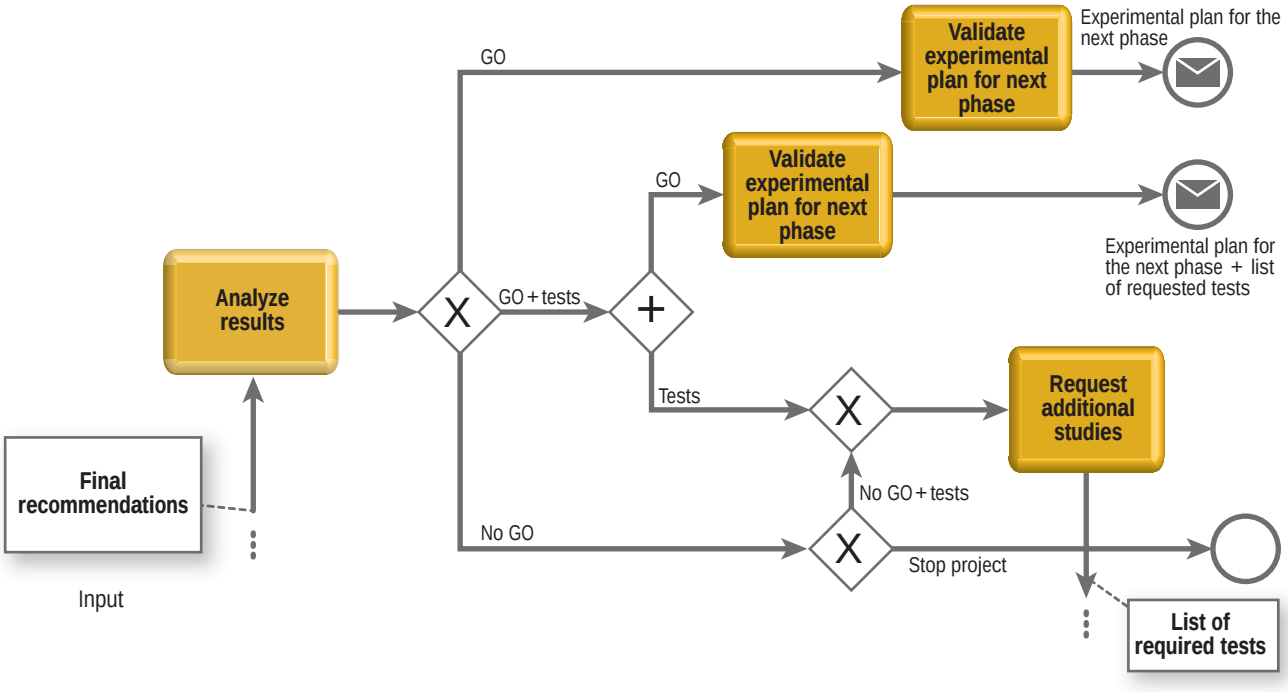

Figure 3. Detailed vision of decision-making in drug development projects.

Time/ Temperature	0°	5°	25°
t_0	13 µg/l	13 µg/l	13 µg/l
t_1 month	12,9999 µg/l	12,9999 µg/l	12,9995 µg/l
t_6 months	12,9998 µg/l	12,9997 µg/l	12,9980 µg/l
t_{12} months	12,9997 µg/l	12,9995 µg/l	12,9935 µg/l
t_1 month + H_2O		12,9994 µg/l	12,9945 µg/l
t_6 months + H_2O		12,9993 µg/l	12,9942 µg/l
t_{12} months + H_2O		12,9991 µg/l	12,9934 µg/l

Table 1. Stability measurement tests

Conclusion

The comprehension of the notion of uncertainty is indispensable for understanding the decision-making process in situations where we do not have enough knowledge to decide. We distinguish two main approaches in defining uncertainty: the objective and the subjective approaches. We propose a new definition of uncertainty that allows these approaches to converge, including three key elements: subject, object, and context. From this point of view, we present a typology of uncertainty factors related to each element. This typology enables us to recognize and control some sources of uncertainty and offers a perspective to deal with causal and influential factors of uncertainty related to subject and context, which are less studied compared to uncertainty caused by object.

Decision-making systems in companies are the human-in-the-loop type systems. Thus, we cannot ignore the role of human factors in generating uncertainty and dealing with / handling it. In the description of the decision-making process in pharmaceutical industry we propose, the human aspect is in the center. We identify different levels of hierarchy in the decision-making system in a pyramid, highlighting the role of the subject and context in producing and dealing with uncertainty. In this pyramid, we illustrate the information flow in two directions: from the steering committee to the technicians and vice versa.

A practical example regarding the question of stability, as a small part of a larger question, the quality of the molecule, is presented. Many other questions have to be answered during the development project. Go / No Go decisions are based on these answers which are inexact and incomplete. This description is a first step to understand why decision-makers postpone decisions in such situations. A more complete model that offers a global vision of the project will be the next step of this research work.

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Evaluating a complexity framework - a practitioners view on project complexity

In literature it is claimed that increasing project complexity is one of the causes for project failure. To prevent project failure and better manage project complexity, previous research delivered a framework to characterize project complexity in the process engineering industry. This paper presents the findings of a survey study in which the complexity framework was evaluated amongst practitioners. Data was acquired on 67 projects performed in the NAP network. The survey contained questions related to the different elements of the complexity framework and to the respondent's perception of the project's complexity (technical, organizational and environmental).
The results of the survey showed significant correlations between elements of the complexity framework and perceptions of the respondents on organisational, technical and environmental complexity. Overall, the respondents attributed complexity most to the "organisational" category, which could be explained by the role of the respondents in the project and their (engineering) background. Also this is explained by the fact that respondents not necessarily limit their answers to causes of project complexity. In hindsight, they seem to focus (even more) on the consequences of project complexity, which are often in the organizational area.

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Introduction

Increasing project complexity would be one of the causes for project failure (Williams 2005). In order to prevent project failure and to be able to better manage project complexity, previous research delivered a framework to characterize project complexity of projects in the process engineering industry (Bosch-Rekveldt, Jongkind et al. 2011). This framework was built from an extensive literature study (including the work of amongst others (Baccarini 1996; Williams 1999; Williams 2002; Shenhar and Dvir 2004; Geraldi and Adlbrecht 2007; Vidal and Marle 2008)) and empirical data from 18 interviews across 6 projects in the process industry. Recognizing that project complexity is a wide, dispersed phenomenon, a detailed framework to grasp project complexity was developed, consisting of 50 elements divided over three categories: Technical complexity, Organizational complexity and Environmental complexity. Now this TOE framework is available, the question is to what extent the elements in the framework are indeed contributing to project complexity in view of practitioners and whether practitioners recognise the potential of such a framework. And, to start with, how practitioners in the process industry perceive the complexity of their projects in general, not referring to complexity elements in the TOE framework.

Methods

To answer these questions, an internet survey was developed. The survey study was performed within the Dutch process industry, particularly within the companies that are members of the NAP network (NAP 2009). The NAP network is a platform bringing together companies from the entire value chain in the Dutch process industry, including engineering agencies and the academic community and consists of about 100 member organizations.

First, it was investigated to what extent the practitioners considered their project being technically, organizationally and environmentally complex. Answers to this question were given on a Likert scale from strongly disagree via disagree, neutral, agree to strongly agree and do not know. The "do not know" answers were treated as missing values. All individual complexity elements from the TOE framework were scored on interval scales. Next, the outcomes of all element scores of the individual complexity elements were correlated to the different perceptions of complexity. Since our scales could not be considered equidistant and the data contained non-normally distributed variables, Spearman's rho correlation was used. Finally, the potential of applying such framework was evaluated by analyzing the responses to questions about the application and usefulness of such a complexity framework.

The survey response data contained 67 completed surveys. This sample size is considered sufficient to do some exploratory quantitative analysis. For firm quantitative conclusions, more data would be required. Based on an exploratory scatter plot analysis, it was concluded that the 67 surveys contained no outlier cases. Hence all 67 responses were included in the overall analysis. Results are presented in the subsequent sections.

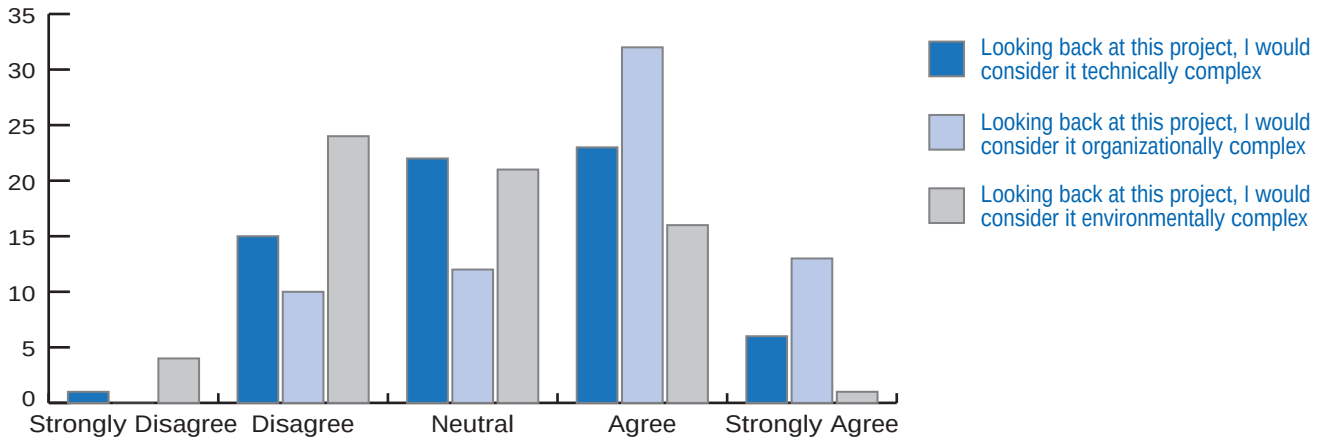

Figure 1. Survey results: perceived complexity

Results: perceptions of project complexity

To measure the perceived complexity of their projects, respondents were asked to give their opinion on the following propositions:

- Looking back at this project, I would consider it technically complex
- Looking back at this project, I would consider it organizationally complex
- Looking back at this project, I would consider it environmentally complex

Results are given in Figure 1. The respondents agreed the least with the proposition about the environmental complexity of their projects. The respondents agreed most with the proposition about the organizational complexity of their projects. Note that our respondents predominantly had a background in science or engineering (61 out of 67). With their technical background, they might consider environmental complexity as something that is not "their cup of tea", or not in their daily experience. The organizational complexities "worry" them more than the technical complexities, which they are educated for to deal with. They seem to follow the "traditional school of project management" in which engineering approaches prevail (Lehmann 2010), in contrast to the "renewal school of project management" where relational approaches dominate the management style.

Inter-correlations between technical (T), organizational (O) and environmental (E) perceived complexity were also investigated. Weak inter-correlations were found: an increase in perceived technical complexity coincides with an increase in perceived organizational complexity (r_s =.320, p=.008, N=67) and an increase in perceived environmental complexity also coincides with an increase in perceived organizational complexity (r_s=.287, p=.020, N=66). This could indicate how respondents interpret "organizational complexity": both technical complexity and environmental complexity seem to have implications for the organizational complexity in their view. E.g. an element that contributes to either technical or environmental complexity also contributes to the organizational complexity. Note that the (predominantly technical) background of the respondents could cause a certain bias.

Results: linking the TOE elements to perceptions of complexity

Next, possible correlations between the individual elements of the complexity framework and perceived complexity were calculated. The significant correlations between the respective TOE elements and any form of perceived complexity are provided in Table 1. In the column "correlation result", 'T' indicates a significant positive correlation to perceived technical complexity, 'O' indicates a significant positive correlation to perceived organizational complexity, 'E' indicates a significant positive correlation to perceived environmental complexity. The significance level of the correlation is indicated with * (0.01), ** (0.05) and † (0.1).

Beforehand, it was hypothesised that all 'T' elements would show a significant relation with the perceived technical complexity, all 'O' elements would show a significant relation with the perceived organizational complexity an all 'E' elements would show a significant relation with the perceived environmental complexity. However, one could argue that the elements of the TOE framework represent the potential causes of project complexity, whereas the perceived complexity is not necessary limited to the causes of project complexity, but also includes the consequence (or implication) of project complexity, which is the perception one has in hindsight. Therefore the correlations that we found indicate how several "causes" of project complexity are perceived by the respondents. This is useful to improve project management, since we need to know both cause and consequence of project complexity in order to better manage it. Because of space limitations, Table 1 only shows those elements of the TOE framework that showed a significant correlation with any form of perceived complexity (29 elements of the 50 elements in total). Please refer to Table 4 in (Bosch-Rekveldt, Jongkind et al. 2011) for al list of all these 50 elements of the TOE framework. The absence of other significant correlations raised the question whether the element's measure was correct, whether the element just was not recognised as having implications for project complexity (in the current project sample with limited data) or whether any respondent's bias was obscuring our data.

From Table 1, it was concluded that the majority of the elements of the TOE framework showed significant correlations to the organizational complexity. Respondents particularly "feel" organizational complexity, whereas the causes of this complexity can be found in either technical, organizational or environmental area. There was one unexpected, negative, significant correlation, between political influence and perceived technical complexity. In the current sample, political influence did only play a role in 13 of the 67 projects and hence the negative correlation seems to be caused by sample limitations. Some confusion might have existed about the interpretation of "environmental". Whereas we intended with environmental the "external" aspects of project complexity, including external organizational issues, some of the respondents seem to have it interpreted in a "green" way (e.g. environmental protection).

We did not ask the respondents to rank the complexity elements amongst each other. However, looking at the results of Table 1, the correlations with the highest significance level

TOE	Sub-ordering	ID	Elements defined	Correlation result
T	Goals	TG1	Number of goals	T†
T	Goals	TG2	Goal alignment	O**
T	Goals	TG3	Clarity of goals	O†
T	Scope	TS2	Uncertainties in scope	O†
T	Scope	TS3	Quality requirements	T**, E†
T	Tasks	TT3	Dependencies between tasks	T†
T	Tasks	TT4	Uncertainty in methods	T*
T	Tasks	TT6	Conflicting norms and standards	O*
T	Experience	TE1	Newness of technology (world-wide)	T†, O†
T	Risk	TR1	Technical risks	T**, O*
O	Size	OS1	Project duration	T†
O	Size	OS2	Compatibility of different pm methods and tools	O**, E*
O	Size	OS5	Size of project team	O*
O	Size	OS7	Number of locations	O†
O	Resources	ORE1	Project drive	O†, E*
O	Resources	ORE2	Resource & Skills availability	O**
O	Resources	ORE4	HSSE awareness	O†
O	Resources	ORE5	Interfaces between different disciplines	O**, T*
O	Project team	OP2	Number of different languages	O*
O	Project team	OP3	Cooperation JV partner	E†
O	Risk	OR1	Organizational risks	O**
E	Stakeholders	ES1	Number of stakeholders	O†
E	Stakeholders	ES2	Variety of stakeholders' perspectives	O**
E	Stakeholders	ES3	Dependencies on other stakeholders	T*, O**
E	Stakeholders	ES4	Political influence	T* (neg)
E	Location	EL1	Interference with existing site	O†
E	Location	EL4	Experience in the country	O†
E	Market conditions	EM2	Stability project environment	O†, E†
E	Risk	ER1	Risks from environment	E**
*** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed)* *† Correlation is significant at the 0.10 level (2-tailed)*				

Table 1. Summary of TOE element correlations with perceived project complexity

indicate which of the elements are more relevant than others, in view of the practitioners. Or in other words, which of the elements are best recognised by the practitioners. Specifically the risk elements in Table 1 show highly significant correlations to the different forms of perceived complexity respectively, indicating that the practitioners indeed recognised the link between risks and complexity of the project. This also yields for TOE elements that relate to the involvement of different parties, such as the elements *dependencies on other stakeholders, the variety of stakeholders' perspectives and interfaces between different disciplines*. These elements all highly, significantly contributed to the perceived organizational complexity of the project, confirmed by the current results. This is also the case for the elements *compatibility of different pm methods and tools, resource and skills availability and goal alignment*. Incompatible PM methods and tools, difficulties in the availability of required resources and skills and non-alignment of project goals coincided with higher perceived organizational complexity. Further, perceived technical complexity highly, significantly correlated to *high quality requirements*, e.g. high quality requirements in a project coincide with higher technical complexity. Although the elements mentioned in this paragraph (or better formulated; their implications on the project's complexity) are best recognised by the practitioners, it would be unwise to leave the other elements unattended, see also discussion section.

Results: opinions about the application of a TOE-like framework

The survey also included several questions related to the application of a framework to assess project complexity. It is realised that responses about the potential use of a tool or system are by definition positively biased: most likely the respondents are too positive in their response. That they indicate they plan to use a tool or system does not guarantee they will do when it is available. However, if practitioners do not support any application beforehand, it is unlikely they will support it once it becomes available. Therefore a positive response on

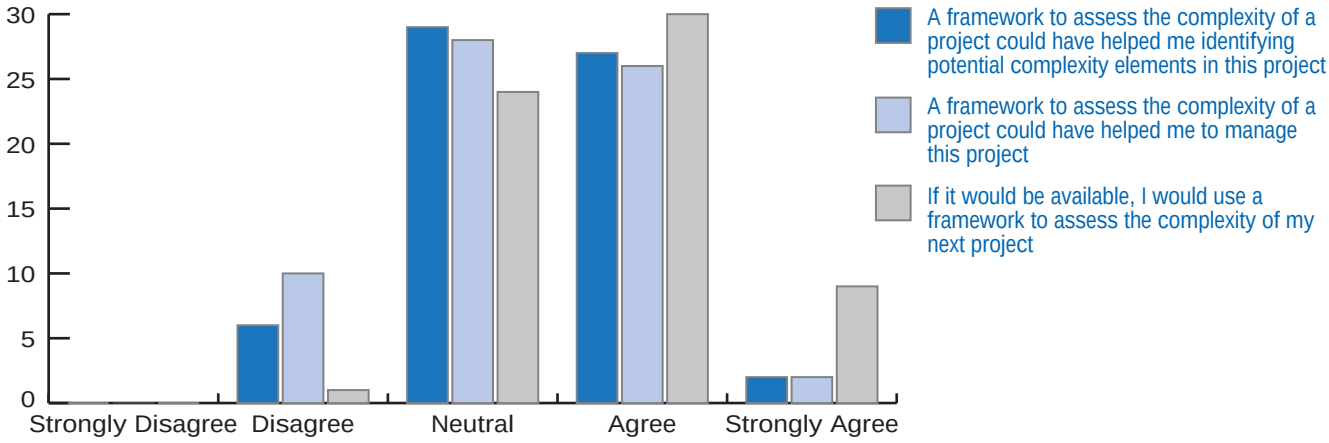

Figure 2. Answers related to application of a complexity framework in the current project and application of a complexity framework in a next project

potential use of a complexity framework is a necessary (but not sufficient!) condition for potential future application.

In the survey, a few questions were related to application of the complexity framework for the respondent's project for which they filled in the complete survey. Only a few respondents disagreed with statements about the possibility to identify complexity elements in their project using the framework or supporting their project management, see Figure 2. The vast majority of the respondents is neutral or agrees that the complexity framework could have helped them in their current project.

Figure 2 also shows that the majority of respondents would use a complexity framework in their next project, if it would be available. So for applying a complexity framework in their next project, they are clearly more positive. This positivism partly could be explained by the fact that respondents probably are more positive about ideas for next projects than for suggestions that could have helped their current project. For their current project, they seem to be somewhat more reluctant (or defensive?) in their answers, although still positive.

Why would the respondents use a framework to assess the complexity of their next project? They clearly see the benefit of applying such framework: the majority of the respondents agrees or strongly agrees that using a framework is likely to be beneficial for the project outcome, see Figure 3.

The intended use of the complexity framework, amongst others, is foreseen in creating awareness about the complexity of the project amongst the different stakeholders in the project. As shown in Figure 3 this was, again, predominantly agreed by the respondents. Only one respondent disagreed, the vast majority agreed or even strongly agreed that using a complexity framework can create awareness about the project complexity amongst the different stakeholders.

Finally, the use of a complexity framework in different project phases was asked for (Figure 4). The majority of the respondents agree with the benefit of applying the framework in different phases (43 responses agree or strongly agree, only one response disagrees). Whether a complexity framework could also be applied during project execution is not clear from this survey: their answers on the proposition about applying the framework only prior to project execution were very diverse. There were 24 respondents (strongly) agreeing and 26 respondents (strongly) disagreeing, the others answered "neutral". However, we know the complexity of a project changes over the different project phases, including project execution (Bosch-Rekveldt, Mooi et al. 2009), and we would suggest that the benefit of applying a complexity framework is not limited to the early project phases (called front end development phase).

Summarizing the above findings about application of a complexity framework, it is concluded that the majority of the respondents supports our intentions of the framework:

- To support project management, beneficially contributing to project success.
- To create awareness amongst the involved stakeholders.
- To be used during different project phases, starting in the early FED phase, but continuing during project execution.

With these intentions, actual use of a complexity framework as a self-assessment tool in preparation of a risk workshop could be thought of. The framework should enable to score

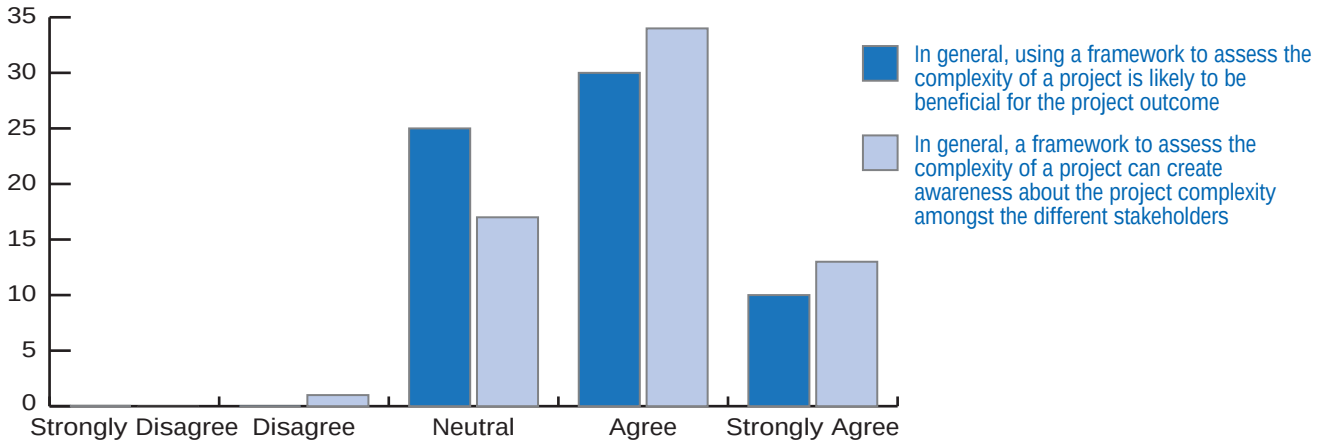

Figure 3. Answers related to the benefit of applying a complexity framework and its foreseen use to create awareness about project complexity amongst its stakeholders

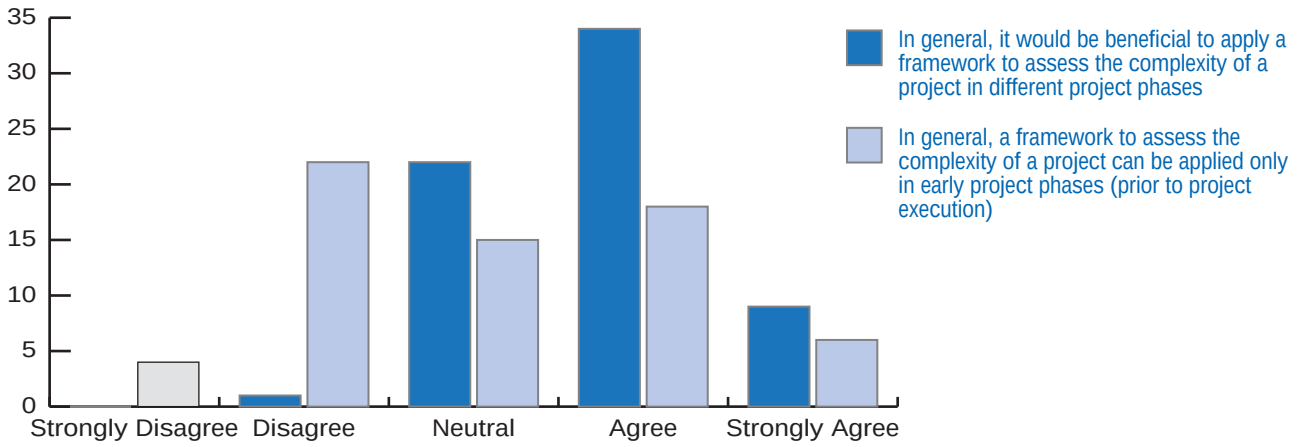

Figure 4. Use of the complexity framework in different project phases

all elements on an equal scale, for example 1 (no complexity contribution) to 5 (most severe complexity contribution). All elements could be scored for a project in its early phase (repeated for all next phases), hence creating a complexity "footprint" of the project in terms of element scores. Next to element scores, some sort of aggregated T, O and E scores per project could be calculated. Based on the (aggregated) footprint, decisions could be taken about managing the specific complexities. By gathering all (anonymous) complexity footprints, a database of reference projects could be created which could be consulted before deciding about how to manage the specific complexities.

Discussion

Before the current complexity framework can be used in actual project management, some further development of the framework is foreseen. A clear scale should be developed for all elements of the TOE framework to allow for comparing project complexity footprints across projects. Here important decisions have to be taken in terms of relative versus absolute measures. Most probably relative measures serve best the ultimate goal of a framework to grasp project complexity, which is supporting the project's management in dealing with specific complexities. How companies and people perceive project complexity is heavily influenced by, for example, their company characteristics and (obviously) previous experience. An absolute measure for project complexity is useless in that sense; but relative measures might be difficult to define. Whatever measure will be chosen, the value of the complexity framework is in identifying the specific complexity areas, which might change during the project.

This study indicates that the involved practitioners (in our case merely with an engineering background) do recognize particularly complexity elements that cause organizational complexity. They seem not to worry too much about technical complexity in their projects. Possibly they feel confident in treating this type of complexity because they are educated to deal with technical issues. This finding confirmed findings of earlier research (Bosch-Rekveldt, Mooi et al. 2009) in which perspectives of project professionals on project complexity were studied following a more qualitative approach. In that study, also organizational complexity was more prominent present in view of the practitioners involved.

The fact that most of the respondents acted as a project manager in the projects under investigation also might contribute to the "dominance" of organizational complexity over technical and environmental complexity in the current study. Environmental complexity, although influencing the project, might be considered as something that happens outside the project and therefore such complexity aspects are simply not recognized by the project manager.

Considering the current data sample, the involved practitioners saw a clear link between a number of complexity elements and their perception of project complexity, more specifically (all correlations with a 0.01 significance in Table 1):

- Goal alignment & perceived organizational complexity
- Quality requirements & perceived technical complexity
- Technical risks & perceived technical complexity
- Compatibility of different PM tools and methods & perceived organizational complexity
- Resource and Skills availability & perceived organizational complexity
- Interfaces between different disciplines & perceived organizational complexity
- Organizational risks & perceived organizational complexity
- Variety of stakeholders' perspectives & perceived organizational complexity
- Dependencies on other stakeholders & perceived organizational complexity
- Risks from the environment & perceived environmental complexity

Here clearly the tendency is observed that respondents "feel" project complexity in consequences in the organizational area. Although these mentioned TOE elements indicate important areas to which more attention could be given in early project phases, it is not suggested to forget about the other elements of the complexity framework. All individual elements of the TOE framework might contribute to the complexity of a specific project, even without a link with perceived complexity as described in this paper.

Extending the dataset could help in further validating the complexity framework. Next to further improving the current complexity framework, future research attention should be focussed on how to manage particularly these complexity elements, in order to increase the chance of project success. A start for this research was given in a paper presented at the PMI Research and Education conference 2010 (Bosch-Rekveldt, Hermanides et al. 2010). The current survey contained, next to the project complexity part that is described in this paper, also questions related to the specific activities performed in the front-end development phase of the project, the success of the project and potential relations between these. First results of these relations were described in the PMI paper.

Conclusions and recommendations

This paper presents the findings of a thorough evaluation of a

complexity framework by means of a quantitative analysis using Spearman's rho correlation. Relevant project data (current sample size: 67 projects) was gathered using an internet survey amongst the Dutch process industry using the NAP network.

The results of the survey showed significant correlations between several elements of the complexity framework and the perceptions of the respondents on organisational, technical and environmental complexity, respectively. Overall, the respondents tended to attribute complexity the most to the "organisational" category, e.g. elements that were assumed to contribute to technical complexity have, in view of the respondents, merely organizational implications. This could partly be explained by the role of the respondents in the project and their, mainly engineering, backgrounds. Further, respondents not necessary limited their answers to complexity causes, but also included complexity consequences (which they directly felt in the project) that are dominantly in the organizational area. Respondents were merely positive about the potential benefit of applying a complexity framework in future projects, for example to create awareness about the project's complexity amongst the different project stakeholders.

Based on the current survey results, further use of the framework in project practice will be tested. The ultimate aim of the TOE complexity framework is to be used to adapt the front end development phase of the project to its particular complexity, in order to improve project performance. Next to use of the framework in early project phases, also subsequent use in later project phases is thought to be beneficial for the project, because of the dynamics of project complexity.

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Intimacy and Quills

The Challenges of Managing By Projects

There are four pillars to appropriately architect the human dimension in managing by projects: expanding the leadership style; creating a high-performance team; acting on the needs and expectations of the interested parties; and establishing effective communication. These four pillars must be worked along the project life cycle which is related to the team life cycle of finding focus, facing the realities, coming together, performing and renewing. Along this team life cycle two enablers must be simultaneously pursued, one technical and the other behavioral. Considering the pillars and the enablers we propose a framework to be used in management by projects that can contribute to project success.

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Introduction

The German philosopher Schopenhauer wrote a parable about porcupines and their dilemmas related to the winter season: the porcupines crowded themselves very close together one cold winter's day so as to profit by one another's warmth and save themselves from being frozen to death. But soon they felt one another's quills, which induced them to separate again. The porcupines were driven close and apart until they managed to find a mean distance at which they could most tolerably exist.

Later, Sigmund Freud quoted the Schopenhauer fable commenting on the concept of intimacy and close communication: how much intimacy can we endure? In other words, how much intimacy do we need to survive in this world? Although the need for intimacy is one of the most common human needs, the distance normally tolerated will always be a challenge. Both Schopenhauer and Freud have used the situation to describe that despite goodwill, human intimacy cannot occur without substantial mutual harm, and what results is cautious behavior and weak relationships. This is also true in managing by projects when human interaction and alignment may often be the determinants of success or failure.

Projects fail for many reasons. On the one hand for technical aspects such as scope creep, overruns of schedule and cost, insufficient resources of funding and personnel. On the other hand due to behavioral aspects such as poor leadership, interested parties conflict, team weakness, unmanaged expectations and ineffective communication.

Projects can and do go wrong. The Office of Government Commerce and the National Audit Office in the UK have identified eight common causes of project failure. Three of the causes are specifically related to the human dimension and with the lack of: clear senior management ownership and leadership; effective engagement with stakeholders; effective team integration between clients, the supplier team and the supply chain.

The findings of the Brazilian Benchmarking Study of Project Management 2010, organized by Brazilian PMI Branches with participation of 460 companies, reveal that from 12 characteristics they value most in managing by projects the first is leadership, the second communication. Interestingly enough team building is seventh. It seems like the benchmarking participants consider that with effective leadership and communication team building will be a consequence. However, without team building, projects may sink into a sea of individualities.

It is a fact that dealing with behavioral issues is more difficult than dealing with the technical ones. The human dimension of managing by projects is of paramount importance and has a great impact on project success. Four pillars are needed to architect the human dimension in managing by projects: expanding the leadership style; creating a high-performance team; acting on the needs and expectations of the interested parties; and establishing effective communication.

Expanding the Leadership Style

Walt Disney mentioned that *"Of all the things I`ve done, the most vital is coordinating the talents of those who work for us and pointing them towards a certain goal"*. Successful leadership involves expressing a vision, influencing and communicat-

Relationship Oriented	Task Oriented	Externally Focused	Internally Focused
Intuitive	Rational	Risk Taker	Risk Averse
Informal	Formal	Rapid Decicions	Slow Decicions
Share Emotions	Share Facts & Data	Impatient	Patient

Figure 1. Characteristic Behaviors

ing with the interested parties to move towards a specific purpose. It also involves developing a high-performance team capable of accomplishing the proposed goal. Leadership is a complex capability and the development of a style is a journey that begins within. It is mandatory to understand yourself before understanding the others.

Jung´s theory of personality development is a good approach to begin this inner journey. Each person has his own habits and his own way of looking at the world. Those traits fall into fairly predictable patterns known as behavioral personality styles. Everyone exhibits one out of four basic styles formed from two opposing pairs: the person being driven either by relationships or by tasks and from being more externally or internally focused. These styles result in characteristic behaviors as shown in figure 1.

These behaviors results into four basic personality styles, figure 2, that allow us not only to better understand and accept ourselves but also to read and respond to others as a way of improving communication and reducing conflict.

Here are the basic personality styles:

Director - Firm, forceful, challenge oriented, competitive, decisive, risk-taker, impatient. Directors are moved by a necessity to be in control, to overcome obstacles and to accomplish results. They work very well to move a project forward;

Visionaire - Optmist who loves to embrace ideas and causes, one after the other. Outgoing, enthusiastic, talkative. They are great in structuring ideas that will result in projects;

Relater - Friendly, operates in a constant and unhurried rhythm. Relaters like stability, and are slow to change. They are fantastic team players;

Thinker - Analytical with long-range objectives, self-controlled and cautious. Thinkers love logic, details, discipline, clarity and order. They work very well in initiating a project and establishing a clear purpose.

Once you understand your essential nature it is possible to start comprehending the others and how to interact in a group. But leadership also involves taking responsibility for people, directing, organizing and motivating them. An experienced leader will gradually refine his style incorporating characteristics from other styles, work on his gaps and assure that the team engages into the same type of process. Even though this is a behavioral and attitudinal journey it needs to be monitored and measured as well. As summed up by Peter Drucker, "What gets measured gets done, what gets measured and fed back gets done well, what gets rewarded gets repeated.". However, success still begins with proficiency in the basic principles of team leadership:

- Creating a common purpose for the project;
- Establishing project team chemistry;
- Building and sustaining trust;
- Driving participation, collaboration and integration.

The leader will also interact with the team using five approaches:

Directing - The ability to articulate, structure and communicate the attainment of a purpose; directing is essential to promote change and achieve results;

Empowering - The ability to help others achieve their individual potential and to facilitate conditions which allow people to express themselves better, recognizing the value of their work and stimulating personal and professional growth as well as self-esteem. Empowering is necessary to achieve results and develop people;

Stretching - The ability to challenge the team comfort zone and involves to compel, to push towards doing more, to go beyond the ordinary towards the established vision. Stretching is necessary to promote change and achieve results;

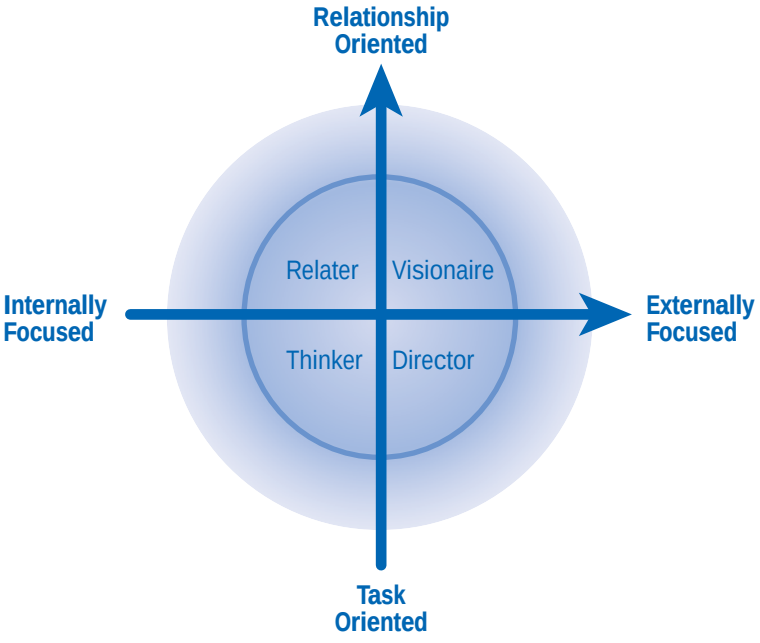

Figure 2. Personality Styles

Figure 3. Whole Product Concept Example

Coaching - The ability to guide and support recognizing the potential of the coachee and taking responsibility for the development of his competencies in order to harvest underutilized potential. Coaching is essential in order to develop people and realize values;

Sharing - The ability to exchange information in order to achieve true collaboration, and permitting access to resources and assuring their utilization. Sharing is required for realizing values and promoting change.

Creating a High-performance Team

As quoted by Henry Ford, *"Coming together is a beginning; keeping together is progress; working together is success"*. Teamwork means people cooperating to meet common goals. In teamwork, productivity is increased through synergy: the magic that appears when team members generate new ways for getting things done and that special spirit for making them happen.

Team building has two enablers, one technical that considers the deployment of the vision into specific goals for the team members, the other behavioral when the team moves from a stage of establishing trust towards synergy. Trust is the foundation for team performance. Team members need a bedrock foundation of enough trust to begin work. Every subsequent interaction either reinforces or undermines the trust they've established. Team building typically follows a lifecycle as presented below:

Stage 1: Finding Focus

When any group forms it lacks a sense of purpose. There is a need to understand what is the structure, the procedures, and to develop an overall vision of the team´s purpose. In addition, each member seeks to define his role. The Thinker and the Director styles can be specially helpful during this phase. The leader's role is to direct these efforts and to encourage to reach consensus and to achieve a feeling of commitment. What does matter is that members buy into the idea of moving forward towards a common purpose. A clear defined common purpose is instrumental in removing ambiguity and should answer 4 key questions:

- What is this team trying to achieve ? (mission)
- What does the end product look like ? (vision)
- What do we need to accomplish ? (objectives)
- How will our success be measured ? (success factors)

One way to build buy-in is through the whole product concept simply defined as *the integrated solution that fulfills the customer's expectations* and used by many teams to successfully establish a common vision for their project. By defining the whole product for a project, the team will understand the mission, have a common vision for performing its work in a collective manner, know what needs to be accomplished, and how success will be measured. Figure 3 illustrates a simple example of the whole product concept in use on a product development project.

Stage 2: Facing the Realities

This phase tends to be a stormy one. You can't just throw together a team of individuals, however talented, and expect mutual trust to ignite. The group begins to feel how difficult the task is, the scarceness of time and resources. This can breed personal frustration, confusion and disillusionment. The commitment to work together is very fragile since each one is trying to make sense of his position. Participation and communication are critical at this stage and Visionaries can often be pivotal encouraging members to participate by sharing thoughts and feelings.

Stage 3: Coming Together

At this stage cooperation and collaboration become increasingly apparent. Members shift focus from doing their part to being part. That is when Relaters can boost team´s evolution helping meld individual differences. The team begins to show consistency between goals and actual results. Since recognition and esteem are important for group members, the leader relies on communication, feedback, affirmation and networking to motivate the team.

Stage 4: Performing

At this point, the team is operating very much on its own. Team members are motivated by achievement and self-actualization. The leader's role in this phase is to serve as mentor/coach and to take a long-range view of future needs. Team members focus on decision-making and problem solving, relying on information and expertise to achieve their goals.

Stage 5: Renewing

Leadership concern is focused on evaluation, review, and closure. Team members continue to be motivated by a feeling of achievement and self-actualization.

Acting on the needs and expectations of the interested parties

In every undertaking there are parties with a vested interest in the activities and results of the project. These parties are called *stakeholders*: individuals with some kind of stake, claim, share, or interest in the activities and results of the project. Identifying stakeholders early on leads to better stakeholder management throughout the project.

All people have expectations that drive the way they interact. Expectations are their vision of a future state or action, many unstated but which are critical to the project success Understanding these expectations and responding to them is an art and expectation management is useful to any area in which human beings must collaborate effectively to achieve a shared result.

The role of the stakeholders and the influence they have is not always understood by project managers. Failure to recognize that people are bound to have positive and negative reactions will only result in disaster. It is the project manager responsibility to consider the ABC strategy for dealing with stakeholders:

Attitude - Think of attitudes as adjectives that describe how stakeholders feel.

Behaviors - Think of behaviors as nouns that represent stakeholders consistent response under specific circumstances.

Candor - The open and respectful exchanges that can emerge when positive attitudes drive positive behaviors.

If attitudes reflect the manner by which you feel and think, behaviors reflect the manner you act. Here are just a few of the linkages between attitudes and behaviors that are important among stakeholders:

- A committed attitude that results in active participation;
- A disciplined attitude that results in preparation and persistence;
- An independent attitude that results in courage to challenge.

Understanding stakeholder attitudes and behaviors permit the project leader and the team to divide them into four categories to be approached with candor as shown in figure 4.

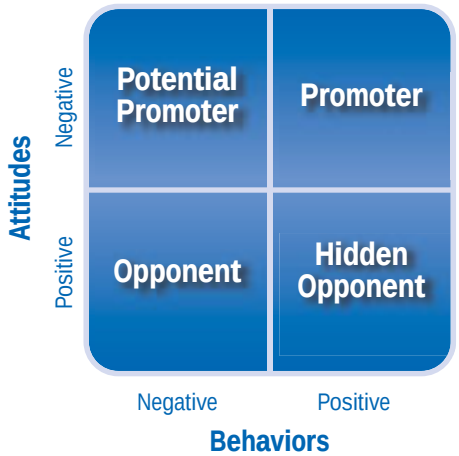

Figure 4. Attitudes X Behaviors

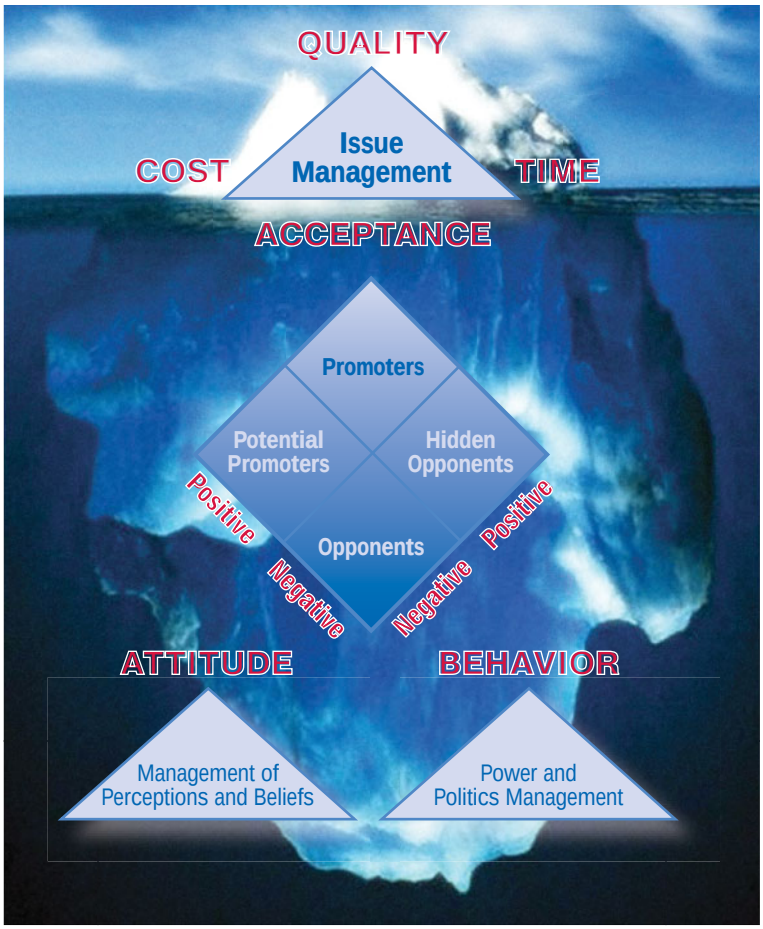

Figure 5. Krueger's Iceberg

The change management iceberg created by Wilfried Krüger, figure 5, is a strong visualization of what is the essence of stakeholder management in managing by projects: dealing with barriers using the ABC strategy. It also offers an explanation why the human dimension is critical for project success. Most managers focus on what they can see above the waterline, the three main issues of acceptance, doing things faster, better, and cheaper. However, they forget that most icebergs extend below the surface hiding perceptions, beliefs, power and politics. These four areas may create great resistance to the project's progress and must be dealt with effective communication.

Before you can manage the emerging reactions or issues you must remember that the transformation resulting from management by projects affect people whom divide themselves into four distinct categories:

Opponents - have a negative attitude and behavior towards the project. They need to be controlled by management of perceptions and beliefs to change their minds as far as possible;

Promoters - on the other hand have a positive attitude and behavior towards the project and will therefore support it;

Hidden Opponents - have a negative attitude although they seem to be supporting the project on a superficial level. Management of perceptions and beliefs supported by communication is needed to change their attitude;

Potential Promoters - have a positive attitude. However for certain reasons they are not

convinced, yet, about the project. Power and politics management seems to be appropriate in this case.

Project managers must study the different stakeholders with the Kruger Iceberg in mind and understand how they can influence project success based on the following steps:

- Identify all possible stakeholders involved in or affected by the project ;
- Gain an understanding of the influences, interests, attitudes and behaviors of the stakeholders towards the project and the importance and power of each one ; identify primary high-level project expectations for each stakeholder;
- Analyze how the products and deliverables affect each stakeholder and their acceptance. Determine what actions the stakeholder could take which would affect the success or failure of the project. Ensure that the agreed objectives and strategies are clearly understood and communicated to all parties;
- Prioritize the stakeholders, based on who has the most positive or negative effect on project success or failure. Incorporate information from previous steps into a risk analysis plan to develop mitigation procedures for stakeholders who might negatively impact the project;
- Identify from the information collected, what information needs to be furnished to each stakeholder, when it should be provided, and how.

Because interested parties have various perspectives on the final outcome of a project, creating differences between their individual needs, expectations and priorities, it is crucial that project managers guarantee that preferences are satisfactorily managed. Keep in mind that sooner is better than later since expectations get firmed up the longer they are left alone. Also, listen, understand, interact with candor to develop trust.

Establishing Effective Communication

Communication provides the basis upon which information flows through a project for getting the right information to the right people at the right time allowing for actions, decisions, changes and execution. The trick is to make the most appropriate match among methods, messages and stakeholders. A typical project communication plan includes the following basic components:

- Communications purpose – the goals and objectives of the project communication process;
- Communications methods – the mechanisms and formats for the varying elements of the project communication processes;
- Communications frequency – the timing and frequency requirements for all formal and informal communication activities;

Projects offer multiple opportunities for communication with your key stakeholders and two types of plan are recommended:

- Regular or ongoing – include communications on a frequency basis such as weekly status reports, scheduled project team meetings, monthly updates with the steering committee;
- One-time or event driven - used to capitalize on important milestones or special events.

Communication is the soul of management and solid decisions. It must be translated into clear messages that influence people to act and feel good about their performance. It is the invisible force that binds a team or creates a harmonious relationship and the prerequisite for the cohesion and development of any team. Without effective communication, there can be no team work and team spirit will be adversely affected. Also, the more interested parties know about the project, the better so that they understand the complexities, the dependencies and the impact their expectations have. The art of communication involves adding SPICE to it:

Simplicity – make it simple but not simpler. Bear in mind that the enemy of simplicity is not complexity but excess;

Perceiving – Understanding, appreciating, and accommodating individual differences in communication style may enhance communication;

Incongruence – most of the literature on communication emphasize the need for congruence. However, intentional incongruence is always important to communication in the sense of adding some humor to it. If you choose to be incongruent in very specific ways, for very particular reasons you'll find that incongruence is incredibly useful. Being intentionally incongruent in really unique ways bypasses people's pattern-matching filters making necessary for them to devote more attention;

Credible – Communications that lack credibility fail to motivate because

Team Lifecycle	Finding Focus	Facing the Realities	Coming Together	Performing	Renewing
Value Question	Why are we here? Where do we want to go?	Who does what, when, where?	How we'll do it?	How we did it?	What have we learned?
Leadership	Technical				
	Purpose	Roles & Responsibilities	Implementation	Results	Evaluation
	Behavioral				
	Belonging	Confusion	Commitment	Synergy	Achievement
Stekeholder needs & expectations	Identify Stakeholders	Analyze Needs & Expectations	Prioritize	Manage	Improve
Communication	Diagnose existing methods and IT infrastructure	Develop Plan - Ongoing - Event Driven	Disseminate	Report Performance	Close-out

Figure 6. Human Dimension Integration in Managing by Projects

they're not persuasive. Simply put, do people believe what you say? Is your reputation based on a track record of telling the truth? Are your estimates accurate, your forecasts realistic and your word solid?

Empathy - The ability to understand and to support the emotional situation or experience of another being with compassion and sensitivity.

On every project four important approaches of delivering information should be considered:

Status Report – compiled and delivered on a regular basis and containing: high-level project status related to time, budget and scope; accomplishments; issues and recommended resolutions; upcoming activities;

Project Website – typically these sites have a high-level overview of the project, timelines, impacts on stakeholders and questions and answers;

Project Dashboard – this unique method ensures that executive-level stakeholders are able to quickly know how the project is proceeding relative to time, budget and scope;

One-page Approach – this idea is derived from Toyota's A3 problem-solving report. It is intended to present the project plan and progress on a single page. The objective is always to keep it simple addressing 5 categories: objectives; tasks; timelines; costs; and main issues.

Summary

Projects are done by people interacting which results in issues associated with the four pillars reviewed in this paper. With the lessons from Schopenhauer, Freud and Jung in mind it is important to bear in mind that the team, and its corresponding life cycle, develop along the project life cycle associated with the leadership approach and the relationship with stakeholders. All based on a SPICE communication as integrated on following figure 6.

The figure 6 shows the path towards greater maturity in project human dynamics. When stakeholders communicate and interact in ways that demonstrate a basis of sufficient trust, they find it easier to commit to the best interests of project´s goals. As they communicate and show their commitment through exhibiting competence, willingness and other trustworthy behavior to their common purpose, they handle disagreements and conflict effectively. The presence of conflict no longer automatically means disastrous or uncomfortable confrontation. As the team builds its capacity for constructive conflict through healthy interactions, it also gains in capacity for paving the path for creativity and innovation. Then, a virtuous cycle is generated to project success. Are they common sense ? As Thomas Edison observed, *"common sense is genius in its working clothes"*.

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Project controlling in mega events: the Expo 2015 case

Although Universal Expositions are an incredible catalyst for the development of hosting cities, they have to face projects' common problems as over-budgets and delays. This last issue is critic since mega events have to respect a mandatory deadline and any delay could cause critical project scope reduction. It is thus fundamental to control efficiently and effectively their progress to obtain the best performances. Despite "project controlling" field is well-documented concerning mega-projects, there is a gap for mega events. In addition, literature focuses on strategic elements without providing operative methods to control the execution phase. This paper fills this gap highlighting how mega-events can be considered as "mega-programmes", suggesting supervision through a project envelope to avoid forecasting problems and proposing a gradual control according to project statuses. These results provide a model to monitor Milan Expo 2015 execution phase, guaranteeing that all projects involved end within deadlines.

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This is an updated and edited version of a paper that was first time published in the proceedings of IPMA 2010 World Congress.

Introduction

On 31st March 2008 the BIE announced that the 2015 Universal Exposition (from now Expo) will take place in Milan with a duration of 6 months, from 1st May to 31st October. The undertaking of such an event requires the realization of a large number of projects in different areas, such as construction, communication, advertising and ICT infrastructures, with the involvement of many stakeholders and a timeframe of several years. Since large projects are often affected by over budgets and delays (Flyvbjerg, 2006), it is necessary to employ in their execution an efficient progress control, to identify issues and find appropriate countermeasures to respect projects goals. Surprisingly literature does not provide specific guidelines or models for project controlling in mega events. This paper aims to fill this gap providing an innovative vision of mega events as mega programmes rather than mega projects. The final goal is to propose a model to be used as early warning system to assure the proper and constant control of the projects, detecting any deviation from the original plan and allowing a prompt management of critical situations.

Literature review

While control methods are well-documented in the standard project management literature, the more the project gets huge, the more this task becomes critical for organizations, since complexity and project dimension affect heavily its manageability (Van Marrewijk, 2005). Milan Expo 2015 is one of the largest projects in Italy because of its financial (16 billion Euros), temporal (10 years planning) and organizational dimensions (Comitato di Candidatura, 2006). It is definitely a mega project according to the definition provided by (Flyvbjerg, et al., 2003) and (Altshuler, et al., 2003);as a consequence it is potentially impacted by two typical problems: cost overruns (Flyvbjerg, 2006) and time delays (Van Marrevijk, 2008).

Expos belong to a particular category of mega projects, which both (Roche, 2000) and (Guala, 2002) identify with the term "mega events". From the project management point of view these events gathers different areas of complexity (Getz, 1997), as their final output is formed by the realization of many different projects, involving public bodies (Guala, 2002) and characterized by a mandatory deadline that has to be respected (Hiller, 2000). Therefore, in case of delays the most common alternative is to reduce the project scope.

Literature does not provide detailed studies about mega events and mega projects useful to identify an efficient operative way to control their progress. On one hand, scholars deal with topics and solutions more suitable for mega projects characterized by technical complexity (De Bruijn, et al., 2008), requiring strong synergies between

partners and shared decision making processes (Van Marrewijk, 2005). Either way, attention is paid to social complexity (De Bruijn, et al., 2008) of the environment where these projects are undertaken, concerning in particular role (Flyvbjerg, 2007) and duties (Short, et al., 2005) of public bodies.

These peculiarities, however, fit large infrastructure projects (Van Wee, 2007) rather than a mega event as Milan Expo 2015. In this case sub-contractors are awarded through separate bids by the Organizing Committee and the limited technical complexity of sub-projects does not require strong synergies and shared decision making processes. Nevertheless, partners' tasks are still related by the logical dependencies in the projects. Therefore in Expos the complexity is usually due to the management of the large number of partners involved rather than technical undertakings and knowledge sharing (as in mega projects). In addition, literature advices on control aspects are too qualitative and limited to general suggestions. On the other hand, literature dealing properly with mega events focuses on strategic problems such as urban development and post expo legacy (9th World Congress of Metropolis, 2008), relationships between stakeholders or political factors (Roche, 2000). The Expo book itself (Linden, et al., 2008), the reference guide for managing an Expo, gives scarce attention to control, focusing mainly on economic strategies, future cash flows and operations. What seems to be missed is an efficient operative method which gives advices to control day by day a complex project as Expo. The aim of the paper is to provide this kind of tool.

Universal expositions and mega programmes

It has been outlined how Expos are characterized by several related sub-projects which have to be completed within a deadline. As a consequence these events are better classifiable as mega-programmes rather than mega-projects.

In fact, (Shehu, et al., 2009) consider a programme as *"an integrated, structured-framework that coordinates, aligns and allocates resources, plans, executes and manages a number of related projects to achieve optimum benefits that cannot be realized if the projects were managed separately"*. It is evident how Expos, doubtless copes with this definition: they are mainly formed by a set of projects which must be planned, executed and managed appropriately in order to reach the established deadline. All these sub-projects are strongly interrelated trough physical and logical relationships even if involving different contractors; finally, their management is centralized in a structured organization (for the 2015 edition the Expo Milano S.p.A.).

Concerning programmes and their management, (Stretton, 2010) reports the surprising gap of scientific literature regarding the management of simultaneous and multiple correlated projects. In addition the literature widely discusses about programmes within a unique company, giving no references to programmes which require different sub-partners and involve different typologies of projects. Furthermore, a real operative method to control large programmes is missing and this is another gap that this paper aims to fill.

Programme controlling

Level of detail and bureaucracy are the most important aspects in managing a programme expecially if related to a public community and are widely discussed in literature: by focusing at an inappropriate level of detail there is the high risk that managers will fail to identify the most relevant issues of the programme. Complexity affecting mega events might suggest an approach oriented towards a well-detailed control of activities, on the assumption that this would be an efficient system to detect any deviation from schedules. (Lycett, et al., 2004) assert that standard approaches to programme management might have an excessive control.

However, large integrated plans are difficult to formulate (Levene, et al., 1996), not only for the programmes dimension but also considering the organizational structure of Expo 2015. In fact this decision may compromise relationships between sub-partners involved: detailed control over a partner is more critical than in a single organization, since relationships are more formal and structured and consequently this solution could be too invasive (Van Marrewijk, 2004). For these reasons, the temptation to control every last detail of single sub-projects should be firmly resisted (Pelleginelli, et al., 2006). On the opposite, (Nieminen, et al., 2008) report how focusing on the programme as a whole, without paying attention to the sub-projects leads to an inappropriate monitoring, with the consequence of not being able to intervene promptly in case of issues. Therefore the focus at the programme level should be on the interfaces between sub-projects or on key milestones. (Levene, et al., 1996) suggest to seek a balance between allowing flexibility to project managers in charge to realize sub-projects and maintain at the same time the necessary level of control and accountability (Aritua, et al., 2009).

Focus at the programme level should be on the interfaces between sub-projects or on key milestones

Furthermore, literature focuses on the so-called "one-size-fits-all" approach to programme management. There is a common perception that organizations should apply a standard approach for the management of all projects in a programme, regardless the project type, size, urgency or type of resource used (Payne, et al., 1999). The presumed benefits are based on the assumption that non-homogeneity adds an important layer of complexity to programme management, hindering comparable progresses reporting and the possibility for people to move freely between projects without having to learn a new approach. However, while in most cases projects within a programme are homogeneous and the engagement required is the same, in an Expo projects are very different, each requiring a specific approach. It has been suggested, in fact, that better results are achieved at a project level when people tailor procedures to the type of projects that they are working on (Payne, et al., 1999). Extending this logic to the engagement between the projects and programmes it is likely that different types of projects will benefit from different management approaches focused on their peculiarities.

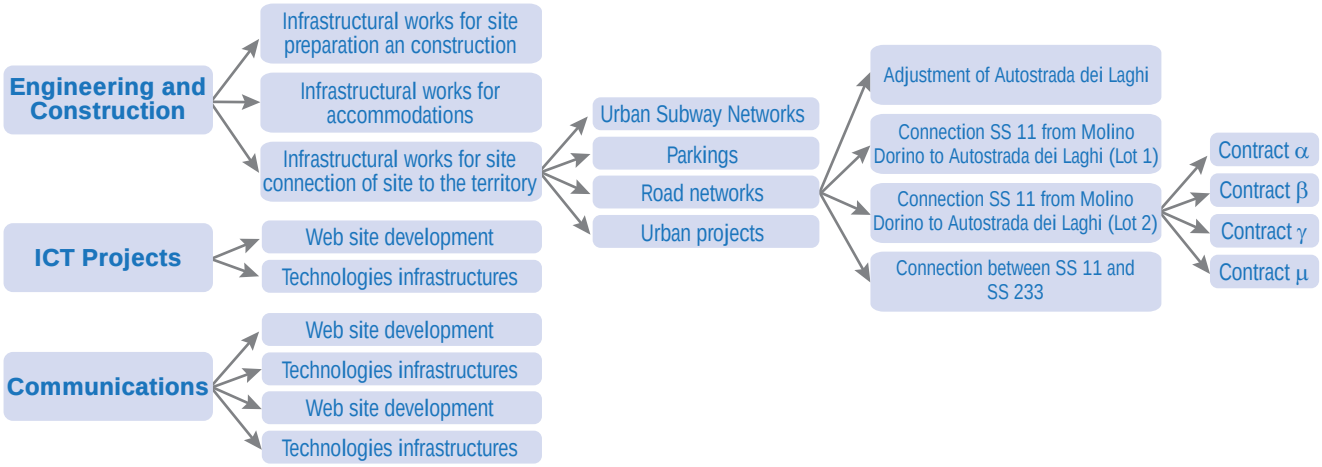

Figure 1. P-Wbs for Expo 2015 execution phase

The model

Considering the literature approaches pointed out in previous sections, the following model aims to identify a suitable model to manage an event as Expo 2015.

Programme Work Breakdown Structure

The first step in order to manage efficiently a huge programme is the disaggregation of the projects involved. The idea is to create a hierarchical subdivision, as the WBS in projects, but able to fit the size of programmes. This solution, called Programme Work Breakdown Structure (P-Wbs) and firstly introduced by (Ipsilandis, et al., 2004) allows a first disaggregation of the programme and a separate analysis of projects in selected macro-areas. (Mavrotas, et al., 2005) suggest a division based on Programme -> Axis -> Measure -> Project -> Contracts, which is the most specific level of detail adopted; this choice is aligned also with (Turner, 2009) remarks. First, the programme is divided into sub-groups ("Axis") of homogeneous projects; each Axis is subsequently divided into "Measures", which classify the projects in a programme in a more specific way. This is a second level of grouping, and it depends on the number of projects which have to be realized. Due to Expo 2015 size, we have introduced a further layer of subdivision, named "Cluster". Every Cluster contains from a few to dozens projects which will be assigned to sub-contractors through separate contracts (deriving from different call for tenders). Each project may have one or more involved contracts, thus it will be subdivided into sub-projects in order to have a one to one correspondence of subprojects to contracts. Figure 1 shows the cited subdivision for Expo 2015. Due to space constraints, Axis and Measure have been reported for the whole programme, whereas Clusters, Projects and Contracts have been limited to a particular branch.

Milestone plan

Each contract will be signed between the society in charge to manage the Expo (in this case EXPO 2015 S.p.A) and single sub-contractors. As this legal agreements generally foresee a number of contractual milestones that allow payments, each sub project will be scheduled according to a milestone plan (Turner, 2009), deputing the scheduling of detail activities to sub-contractors. Since in Expo 2015 time assumes priority above costs (Mazzeo, 2008) and there is not the complete sureness that all contracts will be lump sum, it is neither possible nor advisable to use economic expenses to monitor the status of a sub-project as suggested in (Mavrotas, et al., 2005). Hence, it will be necessary to "downgrade" the level of reporting by analyzing directly its physical progress. A control through milestones is surely the most reasonable solution (Levene, et al., 1996) and in Expo case emerges as the right balance between allowing flexibility and maintaining the necessary level of control and accountability advocated by (Aritua, et al., 2009). Moreover, planning through milestones allows the organization to focus on a result oriented approach, more appropriate for huge dimension projects than activity based approach, which considers a level

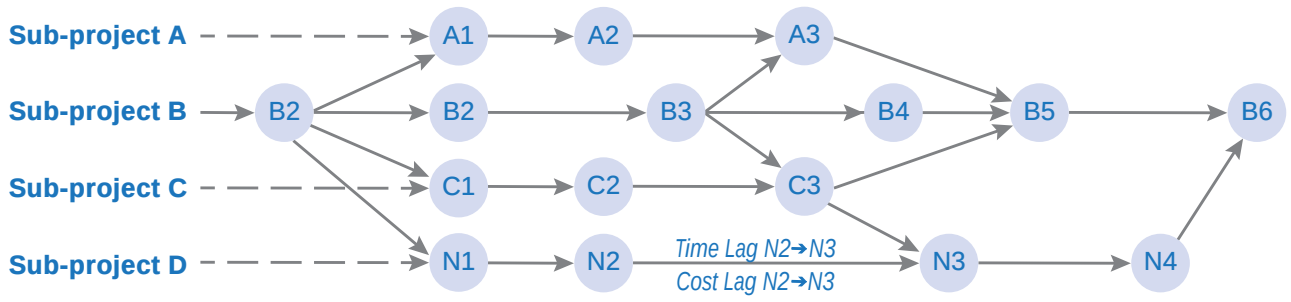

Figure 2. Programme result path

of detail rather impossible to manage (Andersen, 1996). This solution is also aligned with Italian law dealing with projects involving public bodies (Boso, 2006), where usually the progress is monitored through WPC .

Sub-project envelope

Standard project management asserts that comparing actual and planned delivery date of a milestone it is possible to achieve a significant idea of project status. What differs in this case is that the scheduling of a sub-project is spread into different milestone curves. Considering a programme result path (Andersen, 1996), which shows logical dependencies between milestones belonging to different sub-projects within the programme (figure 2),it is possible to schedule them as a common Activities-on-Arrows network (Turner, 2009).

Each time lag will be scheduled according to early, standard and late forecasts, reflecting different planning strategies. The reasonable assumption is that if longer time is foreseen for first milestones (late scheduling), final ones will be faster, due for instance to the well-prepared planning phase (or the urgency to recover the delay). Likewise, early scheduling will achieve later milestone slower. A specific progress is given to each milestone achievement (sec 3.4) and each sub-project is scheduled according to the result path. In this way it is possible to create

- an early curve, which foresees a consistent amount of progress in early phases, whose progress rate will decrease later on;
- a standard curve, which foresees a most likely time lag to reach the milestones, with homogeneous effort spread over project phases,
- a late curve, which foresees longer time to reach first milestones but will earn much progress in later phases.

Each curve will be standardized between 0 and 1 to compare sub-projects (figure 3a and 3b).

The (eventual) crossing of the three curves creates an envelope (figure 3c), which identifies the zone within which the sub-project is likely running in the correct way. This envelope reduces the necessity to operate perfect forecasts about duration, critical aspect in projects or programmes of big dimensions (Lycett, et al., 2004) and gives to supplier the right flexibility to operate without unuseless constraints. Task time estimates are not deterministic (predetermined and exact) and statistical fluctuations are normal in any task execution (Kendall, et al., 2003). Moreover, if detailed and precise forecasts are very difficult even for a single project (Andersen, 1996), this task becomes critical in a huge programme as Expo. The envelope overcomes the inevitable inaccuracy of a single forecast, as it use upper and lower bounds instead of a specific function (Mavrotas, et al., 2005).

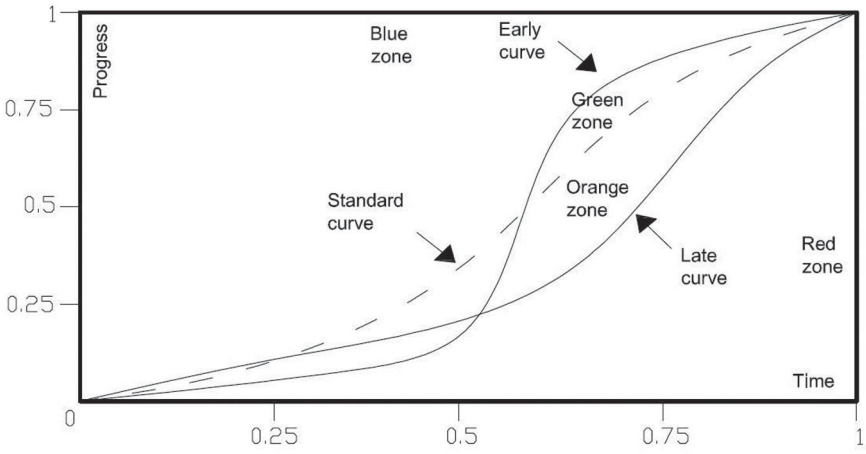

Figure 3a. Contract A

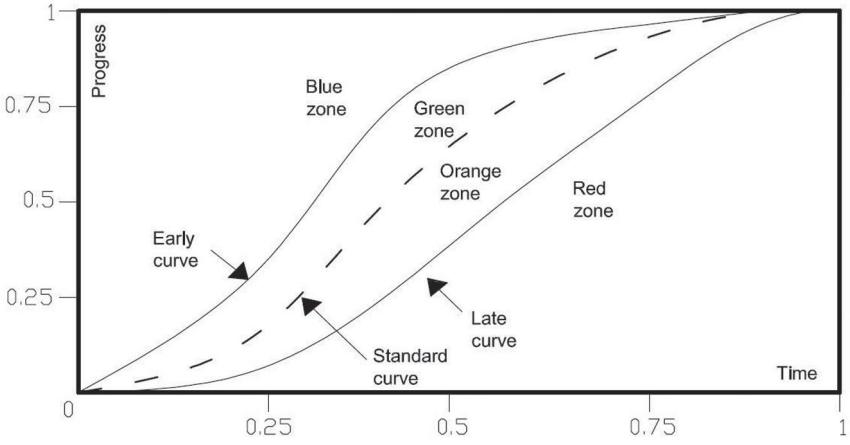

Figure 3b. Contract B

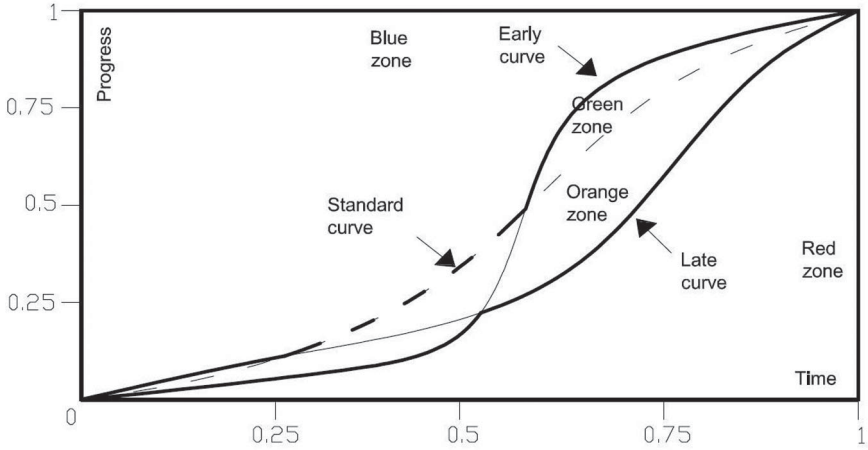

Figure 3c. Contract B and sub-project envelope

Status	Meaning
Green zone	Last actual milestone falls close to the upper bound, thus there are no current problems and no need for further investigations: the Organizing Committee will attend the next milestone check.
Orange zone	Last actual milestone falls close to the lower bound, but still inside the envelope. This situation requires further investigation and preventive contingency plans, such as shorten the time formal reports are produced in order to check more carefully the progress.
Red zone	Last actual milestone falls under the lower bound. The contract is running late and the deadline can be reached just with extraordinary corrective actions. Solutions are changing the sub-contractor, allocate more resources through specific recovery plans (i.e. increase work up to 24 hours a day) or in the worst case reducing sub-project scope.
Blue zone	Considering Expo structure, another situation which should be investigated is when actual milestones fall over the upper bound. This means that the contract is running faster than optimistic expectations, becoming a problem for funds availability.

Table 1. Envelope and Project Statuses

The sub-project envelope permits the creation of a monitoring system based on project statuses, identified according to relationship between actual milestones and the envelope, as table 1 reports.

The limit between green and orange zone is a management decision: for instance, when curves do not cross (figure 3b) this bound may be the standard curve; when crossing (figure 3a) this bound may be a selected curve between upper and lower bound. The green zone does not identify the ideal position where contracts should run. These statuses prescribe correct control reactions according to contract progress. The management decision of defining this bound is influenced by the specific programme and the risk aversion. The ideal strategy for the Organizing Committee is when a contract runs as close as possible to the lower bound, so as to postpone payments but still respecting the deadline. Although economically advantageous, this strategy jeopardizes the sub-project and therefore it is reasonable that it requires more tight control rules (orange zone).

Given the status, corrective actions are part of a good risk management. However, in this way each contract in the programme is monitored with gradual control, increasing attention according to its status (as suggested by (Kendall, et al., 2003)) and it is flexible and opened to contingent adjustment during its execution as advocated by (Lycett, et al., 2004). Furthermore, (Kendall, et al., 2003) assert that in project control is necessary to eliminate as much as possible all the de-motivating measurements. Statistical fluctuations are a normal part of any task execution on a project, so the system must allow for individual tasks to exceed estimates without causing a dramatic postponement of the project deadline. With a single curve which foresees (maybe mistakenly) the development of a project, in case of delays the project team will surely be psychologically affected, feeling in a hurry and start suddenly thinking to corrective actions or scope reduction. With the envelope, issues are split twofold: red status, which requires corrective actions, and orange, which does not necessarily requires radical changes, allowing the chance to recover, guaranteeing flexibility and not increasing excessively the pressure on the team.

Different projects, Different methods

Contracts are related to specific Axis (table 1), and each of them concerns different projects type (figure 2). Hence, (Payne, et al., 1999) suggest that in a programme milestones definition and progress weights should be tailored to sub-projects peculiarities, as a unique method to evaluate them may cause misleading measurements. For these reasons, different types of contracts will be planned and controlled in different methods. Literature proposes several ways to evaluate progress in homogeneous projects. For instance, table 2 reports reasonable solutions for the contracts involved in Expo 2015.

Programme aggregation

Beyond single contracts and their progress, also the evaluation of progress in the whole programme (or in selected sub-parts of it) is important. In this case, (Payne, et al., 1999) suggest a single method is to be found to evaluate the overall progress. Considering Expo case and its different sub-projects, the most advisable solution is to assign a weight to contracts in the P-Wbs. Due to Expo features, these weights will be established by evaluating three different aspects: (a) economics, (b) riskiness (having time constraints, most risky contracts will be the ones with more chances to run late) and (c) strategic importance.. Weights will be identified by experts and by the Organizing Committee, and the overall progress will be evaluated by multiplying this weight by the contract progress identified in sec 3.4.

Axis	Measures	Milestones	% progress
Engineering and construction	Infrastructural works for site preparation and construction	Output components or phases	(Time Lag[a] $M_i \rightarrow M_{i-1}$)/ Σ_i (Time Lag $M_i \rightarrow M_{i-1}$) [b]
	Infrastructural works for connection of site to the territory		
	Infrastructural works for accommodations		
ICT projects	Technologies infrastructures	Lyfe-cycle stages	(Time Lag[a] $M_i \rightarrow M_{i-1}$)/ Σ_i (Time Lag $M_i \rightarrow M_{i-1}$)[b]
	Web site development		
Communication	Event	Each event	(Cost Lag $M_i \rightarrow M_{i-1}$)/ Σ_i (Cost Lag $M_i \rightarrow M_{i-1}$)[c]
	Press	Expo Stages	Level of effort
	Advertising campaign	Campaign phases	(Cost Lag $M_i \rightarrow M_{i-1}$)/ Σ_i (Cost Lag $M_i \rightarrow M_{i-1}$)[c]
	Relationships with participants	Relation. phases	Conventional %

Table 2. Expo 2015 milestone and progress weight

Where "M"= milestone, "i" = milestone of the specific contract
(a) Achieving a milestone will let earn the standard time lag estimated
(b) Σ_i (Time Lag $M_i \rightarrow M_{i-1}$) is the total number of Standard Work Hours (standard scheduling) foreseen in the contract
(c) Σ_i (Cost Lag $M_i \rightarrow M_{i-1}$) is the total cost foreseen for the contract

Implementation

This model has been successfully implemented on a test result path of 20 milestones. For a complete implementation on programme size, actual available IT tools do not offer a rapid way to schedule such an amount of information (Kumanan, et al., 2008). For these reasons, further efforts should be oriented toward the realization of the scheduling through Petri Nets, as suggested by (Cohen, et al., 2008) for simple projects. Furthermore, Petri nets permit to implement automatic verification of time constraints and to reschedule when actual values are available (Del Foyo, et al., 2008), what if analysis through simulations (Kumanan, et al., 2008), and graphical representation of curves (Delgadillo, et al., 2007).

Findings and conclusions

This paper contributes to improve literature contents twofold: firstly, Universal Expositions and mega events have never been considered as "mega-programmes" and there is a clear lack of advices concerning control methodologies. Furthermore, it offers one of the few operative methods in multi-project management field, characterized by fragmented and relatively scarce material, deepening qualitative literature remarks which have rarely been tailored together on a real case. It has been outlined how in large programmes the level of detail should be focused on milestones within contracts and that each sub-project should be analyzed with a specific method to determine appropriate milestones and to evaluate its progress. The project envelope facilitates the issue of identifying perfect forecasts and at the same time gives the flexibility a long-term project requires. Finally, it has been proved that this methodology may be implemented using Petri nets.

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Supply chain sustainability

– a relationship management approach moderated by culture and commitment

This paper explores the nature of relationship management on construction projects in Australia and examines the effects of culture, by means of Schwarz's value survey, on relationships under different contract strategies. The research was based on the view that the development of a sustainable supply chain depends on the transfer of knowledge and capabilities from the larger players in the supply chain through collaboration brought about by relationship management. The research adopted a triangulated approach in which quantitative data were collected by questionnaire, interviews were conducted to explore and enrich the quantitative data and case studies were undertaken in order to illustrate and validate the findings. The aim was to investigate how values and attitudes enhance or reduce the incorporation of the supply chain into the project. From the research it was found that the degree of match and mismatch between values and contract strategy impacts commitment and the engagement and empowerment of the supply chain.

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Introduction

Relationship management (RM) is a system that provides a collaborative environment and a framework for all participants to adapt their behaviour to project (and longer term) objectives. It is about open communication which needs to be facilitated and nurtured. Thus, a 'sustainable supply chain' requires a clear relational strategy that takes into account individual values within the organisation structure (contract strategy in this case) and so empowers decision making, free communication and encourages relationship building.

Effective supply chain management enhances organisation performance and competitiveness through the management of operations across organisational boundaries (Giannakis, Croom, & Slack, 2004). Relational contracting approaches facilitate the exchange of information and knowledge and builds capacity in the supply chain, thus enhancing its sustainability. RM also provides the conditions necessary for the development of collaborative and cooperative relationships. It is about open communication, sharing resources and experiences, exposing the 'hidden' risks in the project. However, subcontractors and suppliers are not empowered to attend project meetings or to have direct communication with project based staff (Dainty, Briscoe, & Millett, 2001). With this being a common phenomenon in the Australian construction industry, one might ask: what are the barriers to implementation of relationship management through the supply chain? In other words, the problem addressed in this research is the engagement of supply chain through relationship management.

Relationship management is a business strategy. It is a system that provides a collaborative environment and a framework for all participants to adapt their behaviour to project objectives and allows for engagement with the supply chain. On the other hand, relational contracting is an approach. A relational contract tends to be of a fixed duration, with exchange of relations in light of opportunities for future cooperation among the contracting parties. After all, companies do not collaborate for the sake of collaboration. They would only engage in relational exchanges when the perceived benefits derived from these activities outweigh the cost incurred.

A contractual arrangement with strong RM, such as committed joint-venture or alliance, allows collaborative and cooperative attitude to develop between project participants. Project parties focus on the organisations' business future and aim for long-term success. The reason for this is a paradigm shift. Relational approaches assist and develop a collaborative and cooperative working environment where trust can be developed and this leads to community benefit and a sustainable supply chain.

The aim of the research is to explore the association between relational contracting structures and processes and supply chain sustainability in the construction industry. The underlying principles which frame this research are relationship management, motivation values, culture and

contract strategy. The objectives of this research are to investigate perception of relationship management from a contractor's perspective and the impact of moving relational contracting down the value chain; thereby empowering and developing a sustainable supply chain.

Contract Strategy

Rowlinson defines contract strategy as being a subset of procurement systems (Walker & Rowlinson, 2009; Rowlinson & McDermott 1998) and uses a typology consisting of seven key variables to uniquely define any particular contract strategy. One of the more important variables is organisation form and it is this dimension that is applied here in this research. Motivation values are context dependent and in construction the organisation form clearly distinguishes one project from another and, in some senses, demands more or less focus on RM as a consequence. For example, the degree of integration inherently present in an organisation form can be represented in Figure 1. The common organisation strategies adopted in Australia in this research are shown in Table 1.

Relationship Management

Relationship contracts are usually long-term, develop and change over time (Cheung & Rowlinson, 2007). RM is a system that provides collaborative environments and frameworks for all project participants to adapt their behaviour to project objectives and allows for engagement of the supply chain. Relational approaches are particularly suited to the Australian culture, where open communications and direct confrontation are accepted and indeed preferred (Cheung, 2006a); such attitudes form a sound basis for relational approaches to be successful. This research seeks to explore the impact of values and attitudes on the success of the RM approach.

Studies suggest that relational approaches, such as partnering, alliances, framework agreements and relationship management, provide positive contributions to social, environmental and economic sustainability and help to satisfy client and stakeholder interests (Blau, 1963; MacNeil, 1978, 1985; Rousseau & Parks, 1993). In other words, relational contracts provide the means to achieve sustainable, on-going relationships in long and complex contracts by an adjustment process of a more thoroughly transaction specific, on-going, administrative kind (Kumaraswamy & Matthews, 2000). The essence of RM is also found in collaborative procurement. Collaborative procurement aims at engaging parties at all project stages; competitive bidding is no longer the only selection criterion for contractors and design consultants, as well as suppliers (Hughes et al., 2006). Also, some reliance is placed on the deliberate development of long-term working relationships which requires trust building. Another characteristic of collaborative procurement is the number of partners is limited. This is particularly crucial in countries such as the UK and Hong Kong, where multi-level subcontracting is a common practice.

The common aim of all relational contracts is to recognise and for strive mutual benefits and win-win scenarios between project parties in a long-term basis (Rowlinson & Cheung, 2003). Thus, RM places strong emphasises on collaborative relationships in the supply chain, proactive problem solving and open and honest communication between project parties; in other words, more collaborative working arrangements and sustainable practices. It is clear that relational contracting is predicated on a broader view of the procurement approach and requires clearly focussed contract strategies and strategic management; it implicitly incorporates supply chain engagement, essential if the performance indicators of best value, community benefit and innovation are to be achieved. One of the main differences between relational contracts and traditional hard-dollar contracts is the problem solving mode where performance problems in relational contracts are solved in a more collaborative manner amongst project team members and senior management, without recourse to claims and litigation (Bresnen & Marshall, 2000; Cheung, 2006b). In some cases, contractors would absorb extra costs in order to maintain good relationships with the client and increase the chances of gaining future business (Bresnen & Marshall, 2000). After all, a partnering

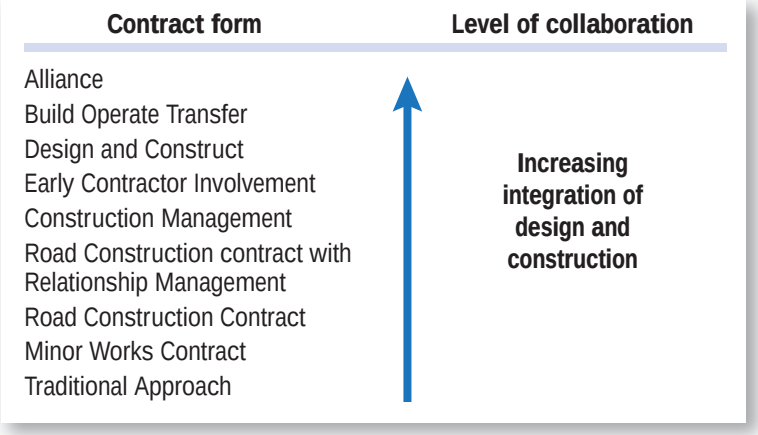

Figure 1. Contract Strategy and Collaboration Potential

Contract Strategies	Characteristics
Minor Works Contract	Design then construct
Roadworks Performance Contract *RPC*	Design then construct
Road Construction Contract *RCC*	Design then construct
Road Construction Contract with Relationship Management *RCC(RM)*	Design then construct
Design and Construct *D&C*	Design and construct
Early Contractor Involvement *ECI*	Design and construct
Alliance	Design, construct and maintain

Table 1. Contract strategies and characteristics

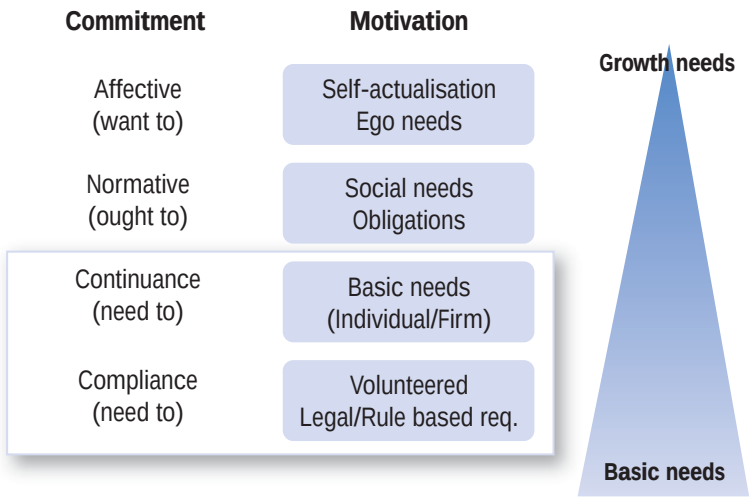

Figure 2. Commitment and Motivation
Source: Allen and Meyer (1996) and Maslow (1970) in Walker & Rowlinson, 2009

relationship between organisations is based on trust, dedication to common goals and an understanding of each other's expectations and values (Construction Industry Institute, 1991).

Commitment

Walker, Bourne and Rowlinson (2008) describe the connections between commitment and motivation using Allen and Meyer's theory (1990) and Maslow's theory (1970), as shown in Figure 2. According to Maslow, human behaviour is controlled by both external and internal environments. Also, individuals have certain needs; these needs do not change in origin and are hierarchal in nature. One must satisfy lower level basic needs before recognises or pursues the next level in the hierarchy. As suggested by Walker et al. (2008), the strongest form of commitment is affective because it is 'want-to commitment' based on a motivation of self-actualisation and/or ego needs, and can move people to contribute beyond expectations.

A RM approach cannot succeed if the collaborating organisations do not accept its ethos. Commitment is an important component of motivation (Meyer, Becker, & Vandenberghe, 2004). Hence, sharing values and being committed to the goals and objectives of the organisation is crucial in client, contractor and supply chain integration.

Motivational Types	Definitions
Power	Social status and prestige, control or dominance over people and resources
Achievement	Personal success through demonstrating competence according to social standards
Hedonism	Pleasure and sensuous gratification for oneself
Stimulation	Excitement, novelty and challenge in life
Self-direction	Independent thought and action – choosing, creating, exploring
Universalism	Understanding, appreciation, tolerance and protection for the welfare of all people and for nature
Benevolence	Preservation and enhancement of the welfare of people with whom one is in frequent personal contact
Tradition	Respect, commitment and acceptance of the customs and ideas that traditional culture or religion provide
Conformity	Restraint of actions, inclinations and impulses likely to upset or harm others and violate social expectations of norms
Security	Safety, harmony and stability of society, of relations, and of self

Table 2. Definition of motivation values (adapted from Schwartz, 1994, p.22)

Values and Motivation

Cultures vary in their underlying values and attitudes (Wood, Wallace, & Zeffane, 2001). The way people think about such matters as achievement and work, wealth and material gain, risk and change may influence how they view work and their experiences in organisations. Schwartz developed a value survey which examines individual motivational types of values and their goals. According to Schwartz (1992b), the meaning of a value can be inferred from its pattern of positive and negative associations with other values. Values '(1) are concepts or beliefs, (2) pertain to desirable end states or behaviours, (3) transcend specific situations, (4) guide selection or evaluation of behaviour and events, and (5) are ordered by relative importance' (Schwartz, 1992a, p.4). Thus, the meaning of a value is best captured by examining the structure of its relations with a comprehensive set of values thus providing insight into the development and consequences of a diverse range of behavioural attitudes and orientations, such as religious belief, political orientation and voting, social group relations, consumer behaviour, as well as the conceptualisation of human values across cultures. By comparing cultural value dimensions between different countries and regions/groups and, indeed, working teams and temporary multi-organisations, one can begin to understand the intercultural meanings in the project environment and so to establish effective relationships in project teams.

RM is about a shared culture between organisations, where the motivation and attitude of the project participants is critical to success. Van de Ven and Ferry (1980) measure a whole series of organisational parameters including individual motivation, work processes and organisational structure. Winch et al. (1997) found autonomy at work, work coordination and work control along with job satisfaction, instrumental motivation and feedback as essential for enabling teamwork and individual motivation in construction projects. On the other hand, innovation, organisational commitment and motivation are strongly related (Khalfan & McDermott, 2006). Referring back to Figure 2, motivation is controlled by both internal and external environmental factors (Maslow, 1970) and is strongly associated with levels of

commitment. It is important for construction organisations to be involved in the innovative procurement practices, such as RM, in order to take advantage of changes in markets. Financial reward might be a motivator for a client to build long-term relationships with other participants within the supply chain (Khalfan & McDermott, 2006). On the other hand, although money might be client's drive for RM, the supply chain might find further job opportunities and organisational competitiveness as attractive motivators for the initial buy-in.

Motivation Typology of Values

The motivation typology of values was measured with Schwartz Value Survey (SVS) (Schwartz, 1992b; 1994). Schwartz (1992b) details the derivations of the 10 basic values. For example, a conformity value was derived from the prerequisites of interaction and of group survival. For interaction to proceed smoothly and for groups to maintain themselves, individuals must restrain impulses and inhibit actions that might hurt others. A self-direction value was derived from organismic needs for mastery and from the interaction requirements of autonomy and independence. Each of the 10 basic values can be characterized by describing its central motivational goal. The SVS measures values at both individual and cultural levels, using a 9-point Likert scale ranging from 1 to 7. Fifty-seven value items were clustered into 10 types of values using the statistical technique smallest-space analysis. The 10 values and their definitions are presented in Table 2.

Research Approach

This research builds on the proposition that the values held by individuals will interact with their context, the type of contract strategy that they are working within, and thus affect motivation and performance and thereby supporting or interfering with the RM process by inducing either collaboration or conflict. Hence, the interaction of motivation values and contract strategy are investigated through statistical analysis of responses from individuals on 98 projects and the findings explained by reference to case studies and interviews undertaken during the study. Thus, the study has been triangulated but the data cannot be fully presented here due to space constraints.

The first step in the analysis was to check the scale reliability and validity; although Schwartz has argued (op cit) that his scale is universally applicable. The relationship between motivation values and contract strategy was then empirically investigated and the results discussed with reference to the interviews and case studies.

Reliability analysis for the 10 motivation values was carried out. Out of the 10 motivation values, stimulation, tradition and security have Cronbach's alpha less than .70, suggesting the items measured in these three values are not highly correlated and the value dimensions do not have high internal consistency.

Results show he most important value for Australian construction professionals is *benevolence* (goodwill for work colleagues), followed by *self-direction* (independent thought and action), *achievement* (personal success) and *conformity* (self-restraint) (see Table 3 and Figure 3). Schwarz (2005a) states "Benevolence and conformity values both promote cooperative and supportive social relations. However, benevolence values provide an internalised motivational base for such behaviour. In contrast, conformity values promote cooperation in order to avoid negative outcomes for self." Hence, one might draw the conclusion that benevolence is an appropriate trait to display in promoting both RM and supply chain sustainability and that this appears to be a dominant value in the Australian construction profession sample. However, further analysis in relation to contract strategy is revealing.

Motivation Values	Mean	Median	Standard Deviation
Power	3.227	3.250	1.307
Achievement	4.791	5.000	.935
Hedonism	4.367	4.333	1.307
Stimulation	4.483	4.333	1.075
Self-direction	4.822	4.333	1.075
Universalism	4.434	4.375	.834
Benevolence	5.147	5.200	.723
Tradition	3.545	3.400	1.066
Conformity	4.739	4.750	1.020
Security	4.639	4.700	.866

Table 3. Mean, Median and Standard Deviation of Australian Professionals on the Subdimensions of the Schwartz Value Survey

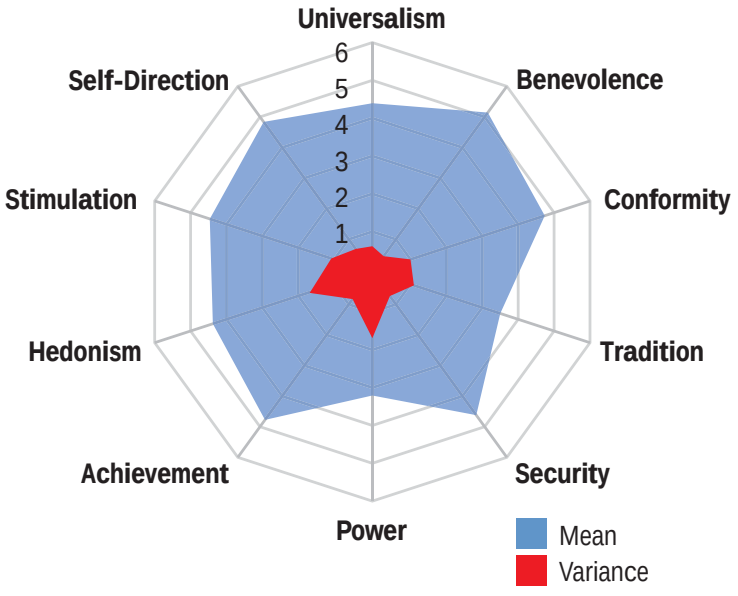

Figure 3. Australian Professionals' Value Dimensions

Motivation Value		Contract strategy (# of cases)						ANOVA (Welch)	
	D&C (4)	Minor Works (8)	RP (10)	RCC (10)	RCC (RM) (26)	ECI (10)	Alliance (30)	df1, df2	F
Self Direction									
Mean	5.45	4.95	4.34	4.88	4.58	5.32	4.89	6, 22.179	2.85#
S.D.	.37	.40	.59	.76	.79	.25	.49		

Table 4. Motivation Values (Self-Direction) by Contract strategy

Motivation Values by Contract Strategy

Except *self-direction*, no significant variance difference is found in the mean motivation values. Although results suggest that there is a significant difference in *conformity* between different contract strategies (ANOVA, p-value of .037), the robust tests of equality of means, Welch statistic, suggest there is no significant difference in *conformity* (p-value 0.066), but a significant difference in *self-direction* (p-value of .033) between different contract strategies. Post-hoc test shows that RPC form is significantly different from ECI form, with a mean difference of -.980 and a p-value of .037, with an ES of -.841. *Self direction* reflects independent thought and action and is exhibited in decisive actions such as choosing, creating and exploring.

Results on how *self-direction* may vary with contract strategy are shown in Table 4. Findings suggested there are significant differences in the degree of *self-direction* with different contract strategies. The post hoc test using Games-Howell reveals that professionals who work on RPC projects have significantly lower levels of *self-direction* than professionals who work on ECI projects. On the other hand, professionals from D&C, Minor Works, RCC, RCC (RM) and Alliance projects do not statistically differ in their level of *self-direction*.

Discussion and Conclusions

The finding that the motivation value of self-direction is strongly correlated with ECI projects is interesting and fits in with the notion that ECI involves both high degrees of collaboration and exploration of alternatives at a stage in the project process where ideas can be 'tossed around' and solutions developed. When this is combined with the motivational value of benevolence this provides an ideal context for collaborative working and inclusion of the supply chain. This proposition is backed up from the case study and interview data. That the converse relationship exists for RPC (hard dollar contracts) is then no surprise with the focus being on delivering a set product for a fixed price with no scope for exploration or any perceived need to include the supply chain. This was again backed up from evidence in the interviews.

From the questionnaire survey it was found, but not reported in detail here, that project teams with strong inter-organisational influences, easy access to information, strong personal acquaintance and frequent group communication are found to have good understanding of organisational structuring and communication. Principal Contractors and project stakeholder groups generally exhibited medium to high levels of consensus. When disagreements arose, the most frequently used resolution method was by directly confronting the issues. As expected, the more often professionals directly confronted issues, the less likely professionals were to avoid or smooth over issues.

Professionals communicated by telephone conversation mostly, followed by face-to-face discussions. Quality of communication between Principal Contractors and project stakeholder groups was found to be highly satisfactory. Findings suggest that good communication quality and strong personal acquaintance result in high levels of agreement. There was a fair degree of agreement between Principal Contractor and project stakeholder groups.

Findings indicate that alliance and ECI projects achieve higher performance effectiveness at short-term as well as long-term levels than projects with either no or partial RM adopted as a management strategy. The motivation values of *self-direction* and *benevolence* were to be found in such project teams and, taking a context dependent view, were instrumental in bringing about supply chain inclusion and, hence, the prospect of sustainability.

Out of the four most important values indicated by Australian construction professionals, no significant relationship was found between benevolence and any organisation variables. On the other hand, *self-direction* related significantly with level performance effectiveness, particularly the longer term view of the company's strategic direction.

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Time-geographic visualisation of stakeholder values:

A case study of city relocation

Successful construction projects include stakeholder management. However, it still is difficult to communicate stakeholders' interest in the early planning processes of complex building projects due to different stakeholder groups and their conflicting values. The question of how city relocation processes are influenced by stakeholder values is investigated in a case study. Secondary data from municipality public information and two in-dept interviews made it possible to analyse stakeholder's action and their values in a city relocation process over time. A time-interest-power model is developed from the analysis. A city relocation project will be influenced by stakeholder's power and interest. However, power and interests are influenced by the perceived values for the different stakeholders. Therefore, communication is important in order to identify values and needs of the many stakeholders in the city relocation processes. One problem for the decision makers is the development of good communication channels especially with the citizens.

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Introduction

Previous studies have shown that stakeholders actively engaged in construction projects may positively or negatively affect the result of the project (Olander & Landin, 2008). Identifying stakeholders by mapping and visualising their influence on project management processes may have a significant impact on the success of projects as well as on project management according to Walker et al. (2008).

A model for analyses of city relocation processes and their influence by stakeholder values with a time-geographic perspective is argued to be of interest for project management. With a city relocation process we describe the complexity of city planning processes ongoing parallel with design and construction processes conducted by actors. Stakeholders influence is investigated in terms of interest and power followed by a discussion of methods for analysing stakeholder values with a time-geographic perspective. Data has been collected within a case study to develop the model discussed in the final section of the paper.

Interests and power

Stakeholders can be identified with different theoretical perspectives. However, these perspectives are in some sense conflicting with each other. One perspective is based on stakeholder roles. Winch (2002, p 67) suggest that stakeholder groups should be described as internal and external stakeholders depending on their relation to the project or organization. According to Winch (2002) internal stakeholders have an active role in the construction project acting as clients, financiers and users on the demand side. External stakeholders on the other hand, act as architects, engineers, contractors and materials suppliers, on the supply side. The research presented by Walker et al. (2008) supports this view by describing how upstream, downstream and external stakeholders may influence internal stakeholders, i.e. project teams. Upstream stakeholders include end users and paying clients organisations. Downstream stakeholders include suppliers and subcontractors. External stakeholders are all groups that in one way or another will be influenced of and by the project (Walker et al., 2008).

Another perspective is when identifying stakeholder groups based on their power influence on the project or organisation. Chinyio and Akintoye (2008) argue that it is important to quickly identify key stakeholders in the early phase of a construction project, i.e. those stakeholders with high power and urgency. Power can be recognized more easily by identifying the one who will authorize a certain key decision, because the urgency of stakeholders changes (Chinyio & Akintoye, 2008). Johnson and Scholes (1999) argue that stakeholder's relative importance for organisations should be investigating by stakeholder groups' degree of interest and power related to the specific organisation. Olander (2006) investigated stakeholders' relationships focusing on roles by identifying their

level of power and interests.

Johnson and Scholes (1999) presented a power interest stakeholder map which can be seen in Figure 1. This approach is an attempt to explain the influences of different stakeholders within in a project in relation to interests and power, e.g. a stakeholder high interest and power are defined as key players. Stakeholders with high interest but with a low power impact need be informed of the progress and activities of the organisation or project. Stakeholders with low interest and low power are of minor interest but stakeholders with low interest and high power need to be taken care of. Olander (2006) argued that one problem with the approach is that the scale is limit to either low or high power and interest values.

For all groups it still is important to investigate if their level of power and interest change over time due to activities related to the specific categories.

Even more complicated are the questions regarding city relocation processes and how the various numbers of related and complex construction projects performed during different time periods are influenced by stakeholder values. According to Freeman (1984) and Mitchell et al. (1997) some stakeholders have a strong influence on society, i.e. legitimate demands and power to use their values when putting pressure on politicians and private and public organizations. Hence analysing changes of stakeholder impact over time, needs a time-space dimension and we suggest a further investigation of how to analyse stakeholder values with a time-geographic perspective.

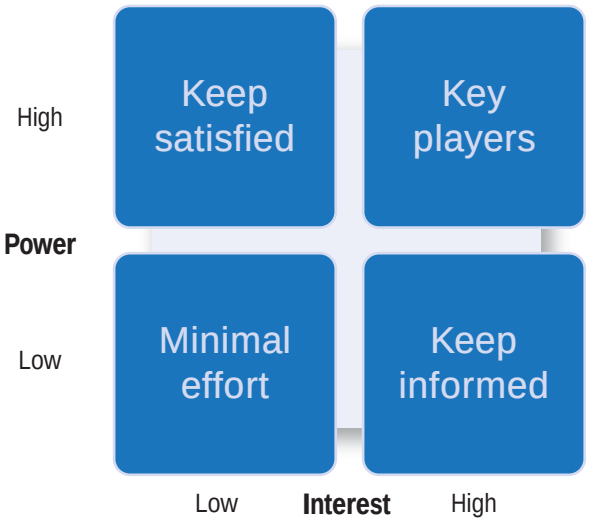

Figure 1. The power-interest stakeholder map.
Source: Johnson and Scholes (1999)

Stakeholder values: a time-geographic perspective

The value concept in construction is in general described in terms of quality referring to product, services, functions, etc. which fulfil the client's needs and requirements according to Wandahl et al. (2007). Saxon (2005) defines value as it is what you give in relation to what you get and it is personal and not an objective fact. Wandahl et al. (2007) argue that values are principles by which we live. Hence, values are visualized by the individuals' habits and manifested in society by people's attitudes presented by Banyard and Hayes (1994: 378-399). According to Barrett (2007) stakeholder values should be managed and balanced in the building processes. Managing stakeholder values also gives an understanding of the business concept according to Saxon (2005). Public construction clients have described their values of public building project for cultural activities, i.e. Houses of Culture (Laurell-Stenlund, 2010). These values were generally described as human beings expectations grounded in personal beliefs, social norms and rules developed in society or related to specific groups, i.e. they are culturally conditioned.

The cumbersome matter is how city relocation processes are influence by stakeholder groups over time at different locations. Out of this point of view we suggest a time-geographic perspective as one way of developing a model for analyses of stakeholder values including time and space.

Time-geographic builds on a holistic approach of how projects are fulfilled by the resources that the actors have access to and constraints they experience (Hägerstrand, 1985; Thrift, 2005). With a time-geographic perspective we analyse resources and constraints for activities in time and space, which are considered inseparable parts of the time-space dimension. The time-geographical view of the world combines the view of objectivity in natural science with the social science view of subjectivity (Hägerstrand, 1976). The approach has become a foundation of different forms of analysis such as innovation diffusion studies (Rogers, 1962/2003) as well as everyday life in households (Ellegård & Wihlborg, 2001).

Our view on the time-geographical analysis is on the actors' roles, arrangement of resources and constraints in time-space. The use of time and space is fundamental for all social and natural scientific processes, but still not commonly integrated as an explicit precondition for scientific analysis. Hägerstrand's ambition was to create a notation system for making processes (irrespective of whether they were human or non-human) visible in the time-space. As a geographer his starting point was the map as a horizontal illustration with time added as a dimension emerging vertically above the map, and he thereby developed the now classical illustration of time and place (Figure 2).

We suggest that the time-space notation system (Figure 2) could be used to analyse processes in time and space. In the time-space trajectories, e.g. different actors' movements, can be illustrated. By identifying stations in time-space, location for specific activities and the relation between them can be illustrated (Hägerstrand, 1953).

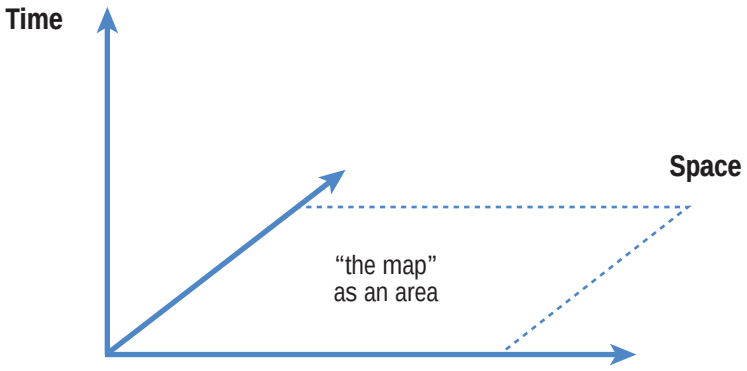

Figure 2. The traditional time-space illustration.
Source: Hägerstrand (1953)

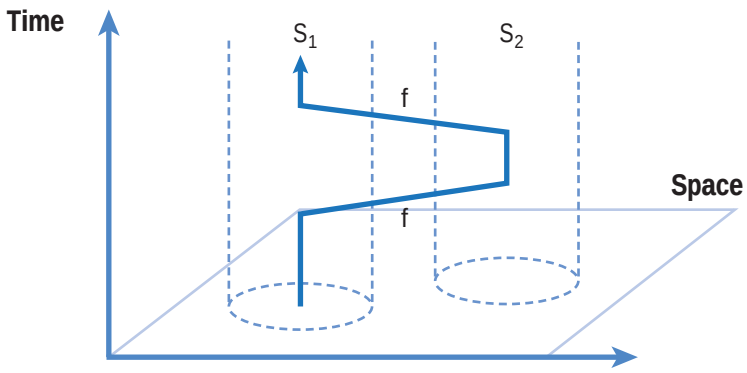

Figure 3. Stations in time-space.
Source: Hägerstrand (1970)

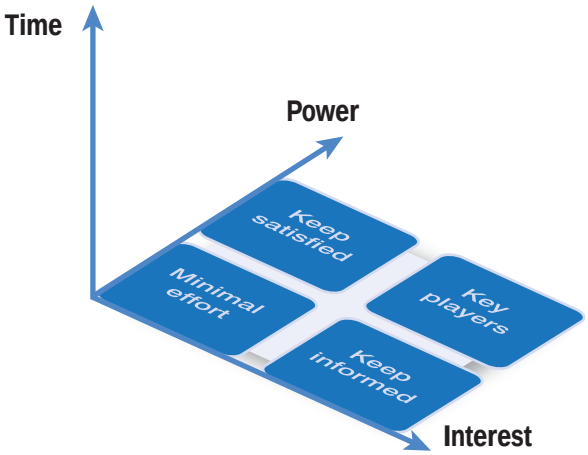

Figure 4. A time-interest-power stakeholder map (developed from Johnson & Scholes, 1999 and Hägerstrand, 1970)

In Figure 3 individuals actions are illustrated by defining two stations indicated by S, which may be for example a home and a school (Hägerstrand, 1970). The thick line f is a trajectory of an actor, leaving S1, visiting S2 and returning to S1. The two stations visualised in Figure 3 could also describe trajectories in virtual spaces, e.g. movements between interest and power.

In Figure 4 the space is presented as an interest-power stakeholder map (Johnson & Scholes, 1999) illustrate movements between stakeholders' interest and power with a time perspective. By illustrating different actions or activities in a time-space dimension the change between interest and power should be possible to visualize, see Figure 4. There may be many reasons for the outcome in time-space, but they all fall back on the basic issue of who was actually in possession of the time-space when a specific process took place, i.e. who has the power and who is able to influence on the action.

Research method

Our research method, a case study, is based on Yin (1994) arguing that case studies are suitable when studying complex processes in general. The case study was chosen based on its possibilities to include different types of data collection and analysis methods within one single case.

Case selection

Our case is the city relocation processes taken part in Kiruna which is causing changes in the urban environments by phasing out and the creation of new urban areas. The city relocation in Kiruna is complex causing high pressure on several construction processes taking part during a long time period.

The selected case is a part of a study within the Nya Giron project which is a European Union research financed project for the relocation of the city of Kiruna. The project is a multidisciplinary project consisting of a research cluster with six different research groups from Luleå University of Technology and the Municipality of Kiruna. Focus area of the project is sustainable development within infrastructure and urban environments. The aim of the projects is to create sustainable and innovative technical solutions which include environmental, economical and social aspects for the relocation in Kiruna.

Secondary data

Data has been collected by using secondary public data from the municipality. This was mainly public information data collected from the website of the municipality and it was sorted and analysed by the authors.

Interviews

Interviews were carried out with the project leader and the town architect, representing the municipality's interest in the city relocation. By selecting the project manager for the first interview and the town architect for the second, we were able to get a broad picture and deep description of the overall planning processes. The selection of the respondents is based on our view that the project manager represents the municipality as a client of a city relocation project. The town architect represents the construction professionals within the public administration organisation, with a professional architectural knowledge and the city planning administration. The interviews were performed in a semi structured way, recorded and transcribed.

Data analyses

From the secondary public information data, a time liner with critical decisions, activities and processes was developed. The activities were also verified by the interviews following a qualitative data analyse method described by Miles & Huberman (1994). The power-interest stakeholder map (Johnson & Scholes 1999) was used in the development of the analysis model with a time-geographic perspective. Key stakeholders were first identified by analysing the official webpage of the municipality. We then made a stakeholder map by identifying different stakeholder groups that we thought were relevant to investigate suggested by Johnson & Scholes, (1999) and Walker et al. (2008). Mapping the stakeholders also lead to our decision to analysis of one stakeholder group and their relation with other stakeholders when developing an analyse model.

We developed our interview guides based on stakeholders' interest in the city relocation process as well as on their power to act within these processes. When we developed the interview guides we treated the municipality as one single organisation representing one stakeholder group. Based on this view we developed the interview questions from factors influencing change processes described in the change kaleidoscope developed by Balogun and Hope Hailey (1999), e.g. time, scope, preservation, diversity, capability, capacity, readiness for change, power; as well

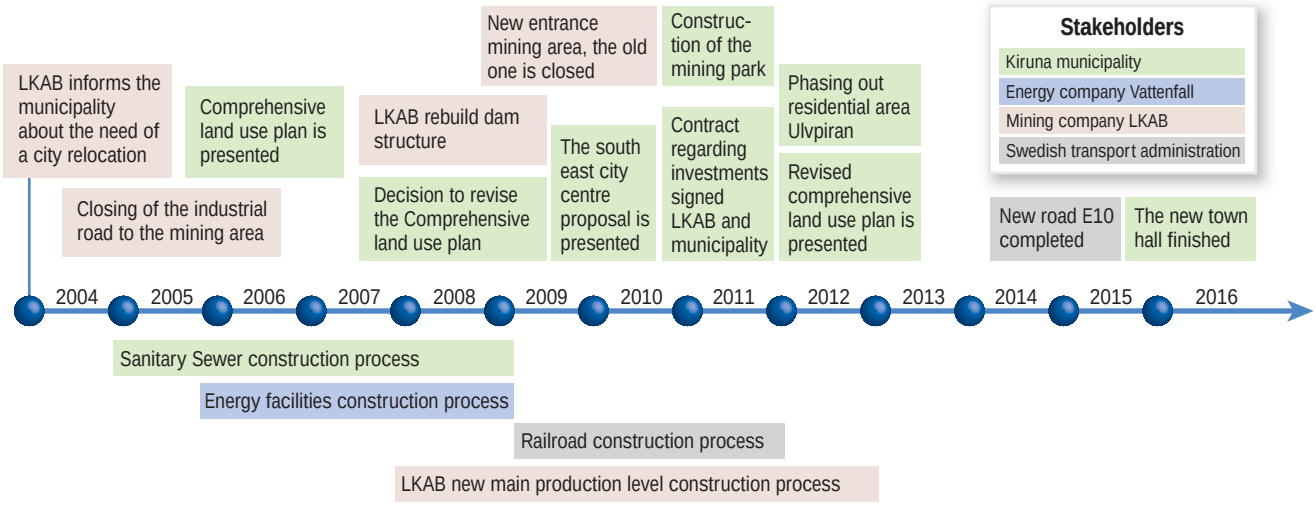

Figure 5. Construction activities and decisions and processes with milestones of a city relocation project

as on questions specific regarding stakeholder values. Our purpose with collecting data from the two respondents regarding these changes factors was to ensure that we got a satisfactory description of the city relocation processes and the factors influencing this process out of one stakeholder perspective, the municipality's, see Appendix were the interview guide is summarized.

The transcribed data files together with secondary data files were exported to the qualitative data analysis tool Nvivo (QSR N6, version 2002) for further analysis. Nvivo allowed us to create categories from theory with focus on one stakeholder: the municipality, the change processes and on stakeholder values. We analysed the data from the interviews and secondary data by coding the data into the categories. The data analysis was the performed with a grounded theory methodology perspective developed by Glaser and Strauss (1967) and Glaser (1992) where new categories were developed from analysing the data within the categories created from theory.

A study of city relocation

In this section the analysis of the city relocation processes is presented after giving a short introduction to the city and the need of city relocation.

City history

Due to rich ore deposits in the northern part of Sweden, the company LKAB has come to a critical point in their activities. After more than hundred years of mining activities, together with their mining technology the company has reached deep ore deposits stretching under the central city of Kiruna. People have been living in the area over 6000 years. The Lappish culture and the Finnish culture have been together as long as we know. The first settlers and mine-workers came during the 1600-century. However, Kiruna or Giron the Lappish name of the city, is a young city, once built on wealth created by the mining activities in Kirunavaara together with the first company directors', Hjalmar Lundbohm, visions and efforts of creating a modern ideal city. The city, just 100 years old, was built on the foot of the mountain with a special street system hindering the cold winds to blow thru the city. Some buildings are also specially mentioned for their architecture, e.g. the church at Kiruna, which was voted Sweden's most beautiful building in 2001 and the City Hall, which got the Kasper Salin price for Swedens most beautiful public building in 1964.

Need of a city relocation

In 2004 the mining company LKAB informed the municipality with a formal letter. It was important for the company to continue their future mining activities and that these activities would affect the city and its buildings. Continuing the exploration of the ore funding, if possible, solutions of moving critical blocks in the city as well as developing the city into a new direction are a must. The public administration received the letter and handed over the question to the politicians according to the project manager:

"It was the start of our journey. The first thing we noticed [the public administration] was that we needed the opinions from the politicians and their view on Kiruna. That is, we needed a program for the city with the politicians' values that we, the public administration, could relay on." Project manager 20101116.

Results of analyses of stakeholder influence and values

A time liner is presented in Figure 5 showing different milestones and construction processes related to a city relocation process in Kiruna. Milestones are defined as important activities and decisions that have or will be carried out by the different stakeholders.

Stakeholders as decision makers and informants

By analysing activities performed within the Kiruna case, i.e. city relocation processes consisting of different activities, stakeholders' involvement in the activities and their power of making decisions have been analysed. The results from the analysis show that stakeholders have different roles in the city relocation process closely related to their power and influence in accordance with previous studies. Key players are in the position of decision makers for all kinds of activities related to the city relocation processes. Stakeholders with high power and lower interest in one specific activity or construction project, still have the power of giving their approval to the decisions made, i.e. stakeholders that should be kept satisfied need to be satisfied due to their power position in the city relocation project, and thus they put a pressure on the decision makers. Stakeholders that need to be kept informed, e.g. interest groups. Interest groups do not have any power of putting a direct influence on the decision makers, however their interests in specific activities taking part in the city relocation process is very strong. This interest gives the interest groups a specific influence. The decision makers need to consider this influence by informing the interest groups before the decisions are made. Finally stakeholders with low power and low interest, in our case the citizens with no interest in specific activities and construction projects performed in the early phases of the city relocation process.

Our analysis has resulted in defin-

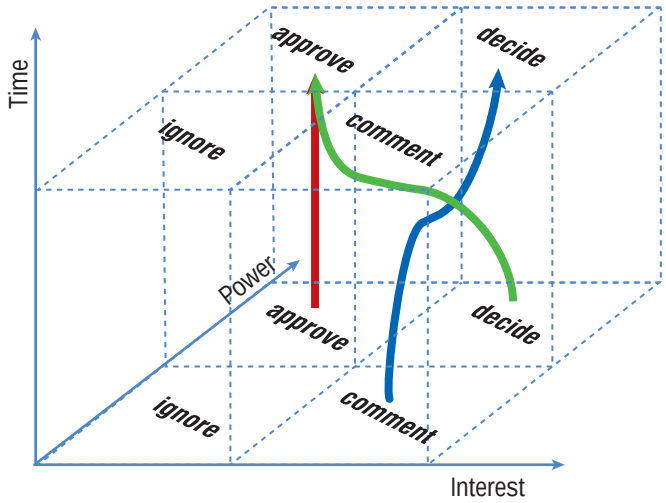

Figure 6. Results from analysis of stakeholders interest and power over time within the time-interestpower stakeholder map

Questions to project manager and town architect

Interviews with project manager and town architect were conducted on the 16th and 17the November 2010 and took approx. one hour.

Presentation of the respondent

What is your profession and what are your working tasks in the municipality? For how long have you been working for the municipality? How your professional career does looks like?

The planning processes

Describe your image of the planning processes in Kiruna as it looks today. What is good and what is less good.

The organization structure of the planning office

Describe the organization of the planning office. What is good and what is less good in current structure? In what ways does relocation of the city influences the organizational structure?

City relocation and its stakeholders

Describe the different change forces of the municipality? What is the value of the city relocation for the municipality? For a successful relocation change, which are the main internal and external stakeholders within the municipalities, which interests should be reviewed, expressed, adapted, agitated? Show mindmap. Kiruna Kommun (municipality), LKAB (mining company), Trafikverket (Swedish transport administration), Vattenfall (power company). Describe how you perceive the different stakeholders change forces behind the city relocation. Describe how you perceive the value of the city relocation for different stakeholders

Power configuration between different stakeholders

Who has the legitimate power in the municipality? How much acting space has the municipality to pull and push the transformation? How do you perceive the responsibility distribution between the municipality and the other stakeholders? Is it a dividing line between how you want to influence and how you can influence and how do you handle that. Describe how your own organisation and other stakeholders influence you. What are the main difficulties for your work within planning for a new Kiruna.

Questions regarding visualization model

In what way do you think visualization can be used for decision making and communication? What are the challenges in that? How do you think that virtual models can be used to support visualization in decision making and communication? What are the difficulties to use a variety of visualization in the city relocation? Do you have any ideas about how the planning can be improved? What kind of feedback do you get for such ideas within the organisation? Your response/responsible/relations to colleagues/acting space.

ing the role of key players as decision makers; keep satisfied is developed into approval; keep informed is developed into comment and minimal effort is developed into ignore.

Shift in level of power and interest over time, due to stakeholder values

Figure 6 illustrated our results from the analysis of stakeholders' interest and power over time within the time-interest-power stakeholder map.

In Figure 6 the green colored trajectory is one example of how a stakeholder can change role. The example illustrates the process of the energy company. This is related to that the company already finished their construction process in the city relocation. A possible shift in power and interests is a reasonable outcome. In order to manage city relocation process there is need of managing the different stakeholders' right in relation with time. In that process communication is vital in order to satisfy and inform stakeholder groups.

From initial analyses of stakeholder groups and their values over time, we can see that there is a shift in their level of power and interest in the city relocation process. The municipality expressed that they initially had a plan of saving the city by moving the city to the new location. Firstly the municipality thought it was possible to keep the main infrastructure, such as the railway and the main road and only move the buildings. After the mining company found new ore deposits, this no longer was an option. The municipality had to develop new infrastructure solutions in the community by initiating sanitary sewer construction processes. Studies of how it should be technical possible to move valuable buildings were accomplished resulting in very expensive solutions and in some cases also technical impossible. One argument from an architectural perspective has also been that some of the identified unique buildings are close connected to the place were they are built. Thus moving for example the City Hall should make the building less attractive.

We can see that traditions from early years still live imbedded in the city articulated by the municipality's vision of developing the "new" city influence by the spirit of the first company directors', Hjalmar Lundbohm, visions and efforts of creating a modern city. The municipality is acting as a decision maker. The municipality makes the decisions regarding the infrastructure and rebuilding public houses, influenced by the mining company's power of exploring the land resources.

Discussions and Conclusions

An analysis of stakeholder power and interest, driven by values within a time-geographic perspective has been presented. The time-power-interests stakeholder model is used to visualize and explain how different stakeholders' interest and power change over time. This approach connects stakeholder's interests-power with time and space relationships.

Our main conclusions are that when relocating a city, stakeholder roles influenced by their power and interest are not only related to specific activities and construction processes, they are also related to stakeholder values. Thus, it is important to make these values transparent for the decision makers through proper communication. One of problem discovered for the decision makers in the case study is the development of good communication channels especially with the citizens. Little feedback was found from this group in the secondary data. The potential benefits of including these stakeholders groups are therefore high.

To support communication and decision making processes needs information of future activities, both in and time and space, to be disseminated to all stakeholders. This is a major challenge in the city relocation project studied, where the power-interests map is continuously changing over time. Therefore time-space information needs to be created, shared and used in a simple and efficient way to handle the different stakeholder's values, power and interests.

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Structuring of Project Teams and Complexity

Project activities at the various levels within the delivery process have an influence on each other. This generates interconnections and boundaries between the activities as well as the individuals within a team, and teams as whole entities, within the project. The interconnection structures often give rise to complexity, which could lead to a reduction in performance if the resulting interface is not purposefully and efficiently managed. Understanding the characteristics of complexity caused by interconnections and their effect on the performance will enable better management of project teams. The authors present the results of a multi-method study of construction organisations to highlight the effects of complexity generated by the interconnections. Complexity in the management of projects and in particular the sub-process of structuring teams are reviewed in order to investigate the level of actions required to manage the effects of complexity. The results from the study have significant implications for the way the sub-process of structuring teams in projects is currently conducted and present opportunity for achieving innovation in the organisation of project teams.

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Introduction

Construction projects often involve a large number of activities comprising several entities and interconnections to create an activity workflow that is aimed at delivering the project. The nature and categories of the interconnections in a project can generate complexity with defined characteristics. The various entities involved in delivering the project are normally streamlined to minimise any potential stricture that could arise from workflow. However, current practices in the management of socio-organisational aspects of a project lend themselves to such streamlining in a rather limited way. The limitation streamlining occurs because the conditions that give rise to changes in interactions, from an organisational standpoint, involve methods that are unsuitable for the construction projects. Also project practitioners continue to approach the sub-process in a transactional rather than transformational approach. Within this paper the authors present the results of a study which explored the conditions that give rise to complexity of interconnections in the management of projects and in particular, the effect on structuring teams. A multi-method approach is employed to investigate the implementation of existing practices, understanding of complexity in projects, and innovative actions proposed to address the complexity of interconnections in the sub-process of structuring teams by managing its characteristics. The outcome of the research suggests that complexity of interconnection in the sub-process of structuring project teams is not managed. The study provides a simple and innovative way of how it can be mitigated by taking actions against the conditions that create them.

Author	Proposal
Fractal structure and empowerment	Breuner, 1995
Self Organisation	Donovan, 1996
Chaordic structure	Senge et. al., 1999
Inverted structure	Liker, 2004

Table 1. Suggestions on structuring teams

Review

Structuring project teams

Structuring project teams requires considerable effort and involves dealing with socio-behavioural as well as technical, integration and control issues and these have been identified and described extensively (Galbraith, 1973; Mintzberg, 1979; Hotstede, 1980; Boisot, 1987 and for construction Lansley, 1994; Turner, 1999; Hughes, 1989; Newcombe et.al., 1990; and Shirazi et.al., 1996). Whilst it is possible to discuss each of the factors in detail the most significant ones in so far as this paper is concerned are those of the interconnections or boundary regulation, project environment, integration and control.

Lansley (1994) and Shirazi et.al., (1996), considered the latter three for construction projects and suggested structures in a two dimensional (2D) approach. Additionally, in order to accommodate requirements from Complex Adaptive Systems such as the project teams, suggestions have been made for the implementation of transformational structures in conjunction with sapiential authority and empowerment, which provide decentralisation, flexibility and adaptability (Moore, 2002; Bertelsen, 2005).

Other suggestions, considering notions ranging from complexity and chaos theory to behavioural and biology concepts have also been made and presented in Table 1.

However, as revealed in literature, theory is not applied and the insistence in implementing transactional organisations in construction projects, which is unsuitable for complex, and dynamic conditions (Moore, 2002; Bertelsen, 2005), means placing authority in the hierarchical position, separating it from knowledge (Andersen, 2003) and imposing a linear approach to non-linear project systems (Moore, 2002; Bertelsen, 2005). Glass ceilings within structures (Green, 2006), unofficial structures (Panas, 2006), short-termism and cost demands have a detrimental effect on structuring of project as discovered by Winter and Smith (2006). Project Managers (PMs) do not consider how to structure their team or the idiosyncrasies of projects (Moore, 2002; Busby and Hughes, 2004). Transformational structures and non-linearity are overlooked unless there is specific interest from someone knowledgeable (Busby and Hughes, 2004).

A number of questions are raised that need to be investigated in terms of:

- the approach taken by practitioners;
- if the environmental conditions are considered; and
- if the effects of complexity are considered when structuring project teams.

Complexity

The management of project transpires in a complex environment (Bertelsen, 2005). The application of complexity theory to the management of complex adaptive systems (CAS), which seek to understand the behaviour of individual elements (Stacey et. al., 2002), within projects, can enable the systematic considerations of the conditions that give rise to such complexity. Various authors have indicated that in construction interfaces cause complexity (Baccarini, 1996; Gidado, 1996; Williams, 1999). Lucas (2000a) argues that complexity is associated with the interconnection structures that link various objects than the objects themselves. This is also confirmed by Burns (2005) who emphasises the need to deal with complexity at the lowest organisational level, the interactions between the systems and the formulation of tenets of interactions. The conditions in the project environment can be considered as optimisation of the structuring of interconnections that link up the delivery systems and subsystems. Understanding the characteristics of these interconnections especially from a socio-organisation standpoint can contribute to the design of more efficient project delivery structures. In particular, it should enable project managers to respond with the necessary actions and improve the setting up of projects, as well as other project management processes. Lucas (2000b) has suggested that complexity arising from interconnections reflects distinct characteristics as depicted in Table 2. Those characteristics that are directly relevant have been mapped onto project conditions and detailed description has been presented in Antoniadis et.al., (2006).

Characteristic	Lucas' Description of complexity characteristic
Autonomous agents	Complex systems are generally composed of independent or autonomous agents (not the identical parts often assumed in science). All of these agents are regarded as equally valuable in the operation of the system.
Instability	Over the long term stepped evolution or catastrophes will exist (similar to punctuated equilibria). Sudden swaps between attractors become possible as the system parameters approach the boundaries of the attractors
Non-equilibrium	Energy flows will drive the system away from an equilibrium position and establish semi-stable modes as dynamic attractors
Non-linear	Complex system outputs are not proportional to their inputs. Taking the properties of each part and adding them will not give a valid solution ... the whole is different than the sum of the parts.
Attractors	Self-organization relates to the presence in the system of dynamical attractor. Each attractor occupies a relatively small area of the overall state space. The system is expected to contain multiple alternative attractors, giving several different possible behaviours for the same system.
Co-evolution	The parts are regarded as evolving in conjunction with each other in order to fit into a wider system environment
Self-modification	Parts can change their associations or connectivity freely - either randomly or by evolved learning procedures
Self-reproduction	Systems have an ability to clone identical or edited copies, ... copying errors permit new system structures to become available, allowing open ended evolution ad self-generation.
Downward Causation	The existence and properties of the parts themselves are affected by the emergent properties ... of the whole which form boundary conditions on the freedom of the constituents.
Mutability	Random internal changes (mutations) or innovations typically occur in these systems. New configurations become possible due to part creation, destruction or modification.
Non-uniform	Each part evolves separately, giving a diversity in rule or task space
Emergence	The properties of the overall system will be expected to contain functions that do not exist at part level
Phase changes	Feedback processes lead to phase changes, sudden jumps in system properties
Unpredictability	In such interacting systems a chaotic sensitivity to initial conditions can occur
Non-standard	... initially homogenous systems will develop self-organizing structures dynamically
Undefined values	The meaning of the system's interface with the environment is not initially specified and this must evolve

Table 2. Complexity characteristics (Lucas, 2000b)

Construction projects are typically characterised by complexity and non-linearity (Bertelsen, 2005); under time and/or cost pressure and requiring both creativity and cooperation. Analysis of complexity in construction projects has been conducted mainly from the technical perspective (Gidado, 1996; Lillieskold and Eklstedt, 2003). Only recently the subject of complexity has been linked to other non-technical project aspects such as organisational and socio-behavioural ones (Kallinikos, 1998; Geraldi, 2008; Girmscheid and Brockmann, 2008). Therefore much of the socio-organisation complexity can be associated with the organising and structuring systems designed for the management of projects, and forms the focus of investigation in this paper.

Research Method

The literature review has provided strong indications regarding the implementation of appropriate techniques for the structuring of the teams and the importance of complexity of interconnection in construction projects.

The following research question was formulated from the above review:

Complexity of interconnections can be mitigated by structuring project teams.

In order to investigate how the sub-process of structuring project teams considers complexity of interconnections and establish the inter-relationship a multi-research method was designed comprising of a postal survey, interviews and case studies and implemented on a stratified sample. The postal questionnaire aimed to establish current levels of implementation of the process. Due to the intricacies on the subject of complexity and its characteristics it was considered appropriate to carry out open-structured but closed response interviews investigating the current understanding of complexity, its characteristics and the implementation of techniques that will manage its effects. Finally in order to establish the relationship between complexity and the process of structuring project teams case studies were considered as the best method and these will monitor the effect of complexity characteristics onto project performance.

The stratified sample consisted of two strata – client and contractor project management practitioners – thus covering both sides of the project. The strata comprised of six of the largest utilities client and construction organisations in UK, with known sample populations thus reducing the stratification drawback of producing erroneous results and minimising the random-sampling error.

Both postal and interview questionnaires were prepared and piloted with professionals from three organisations and a number of corrections were made. In discussions with Senior Management from each organisation the following were established:

- Postal questionnaires were issued to the Project Management divisions which encompassed professionals from Site Manager to Project Director (PD) level;
- 31 interviews with PM practitioners again from Site Manager to PD level;
- 5 projects were selected to participate in the case studies.

Results

The implementation of the multi-methodology research design was over a period of ten months from May 2007 to February 2008 with presentations to respective Senior Managers on the aims and objectives of the research.

Postal Questionnaires

Questionnaires were issued to 180 randomly selected project practitioners from within the two strata and 91 valid responses were returned (51%) - 57% from the client strata and 43% from the contractor strata. The sample of respondents represented 32% and 8% of the respective strata project management populations and 7% were at Director level, 37% at Senior PM level, 46% at PM level, 7% at Assistant PM level and 3% at Site Manager level.

In order to establish the current project environment prevailing conditions respondents were requested to provide an indication in a Likert scale 1 – 5. The results indicate that the environment is mostly Dynamic, Complex and Friendly (Antoniadis

	Overall %	Client %	Contractor %
Discipline Leader	10.2	11.5	8.3
Team Leader	34.1	48.1	13.9
Supervisor	15.9	3.8	33.3
Team Members	29.5	25.0	36.1
None	10.2	11.5	8.3

Table 3. The lowest level down to which PMs defined the project structure

	Type of Structure					
	Matrix	**Functional**	**Network**	**Team**	**Mixture**	**Don't Know**
Discipline leader	39	26	1	13	7	14
Design team	33	27	8	15	7	10
Construction team	23	30	2	27	6	12
Support team	18	31	1	14	14	22

Table 4. Type of structure per organisational level in percent of total response

et.al, 2008). The response regarding down to what level PMs define the project structure are shown in Table 3.

Respondents were also asked to indicate the type of structure followed at different organisational levels. The responses obtained are shown in Table 4.

Interview results

From the 31 interviews conducted the majority of interviewees indicated that their organisations do not define nor provide any tools or techniques to identify complexity (Antoniadis et al, 2008).

Figures 1 and 2 show responses obtained regarding identification of factors which are considered as source of complexity at company and individual PM levels respectively.

Figure 3 provides an overall indication of the average weighted effectiveness of the actions currently taken to manage the effect of each complexity characteristic when structuring the project teams.

It should be noted that during the interviews proposed actions for management of complexity through its characteristics were reviewed with the interviewees and any additional actions were included in the listings and considered in the overall weighting.

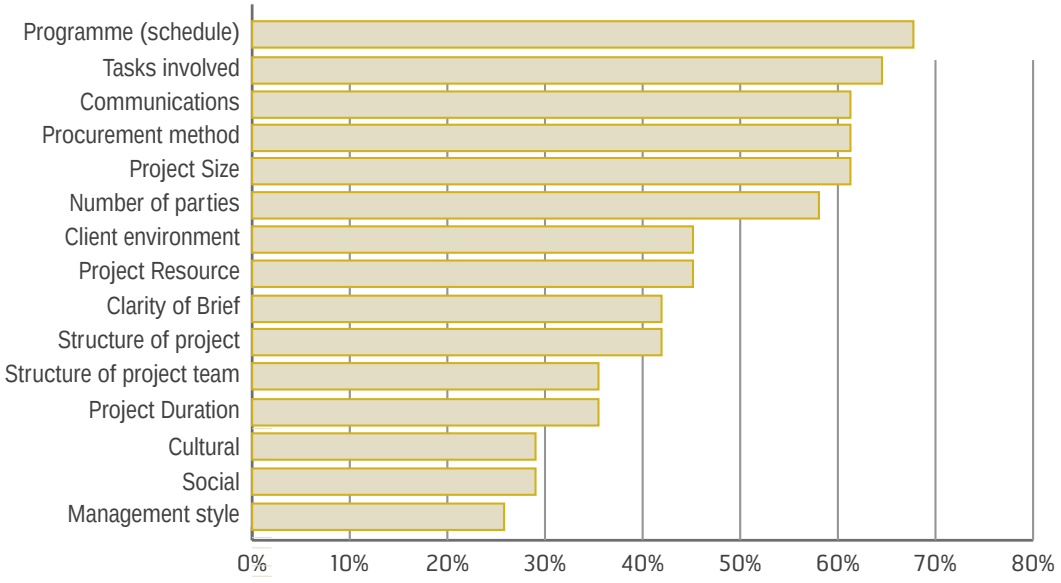

Figure 1. Response regarding the identification of complexity in projects at company level

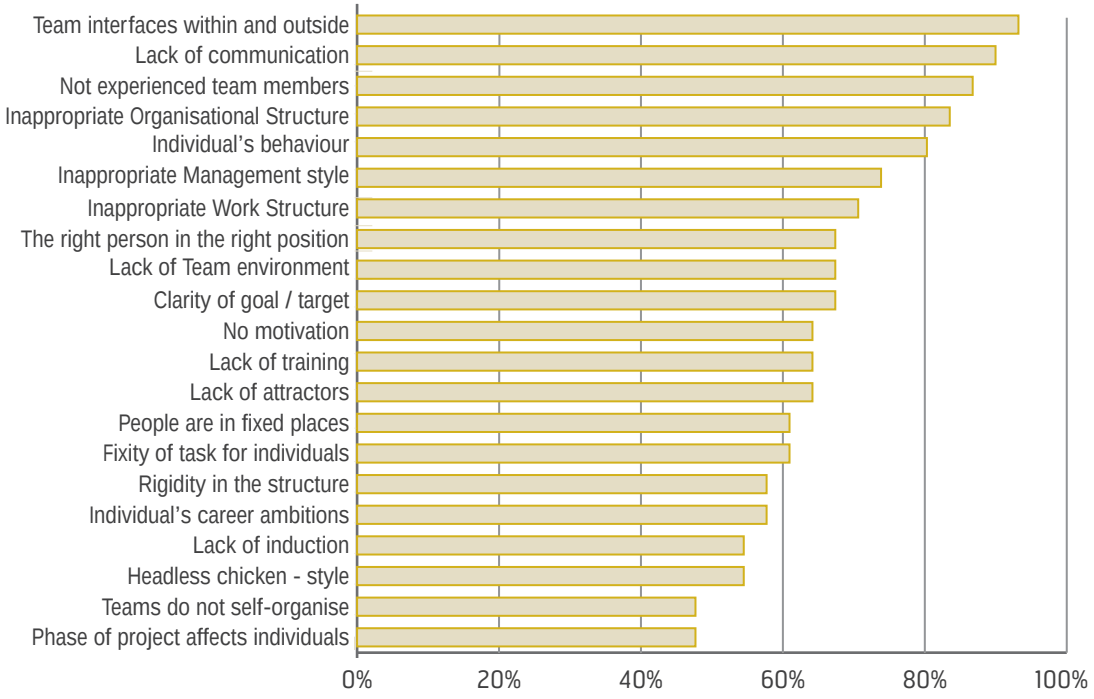

Figure 2. Factors identified by respondents as source of complexity

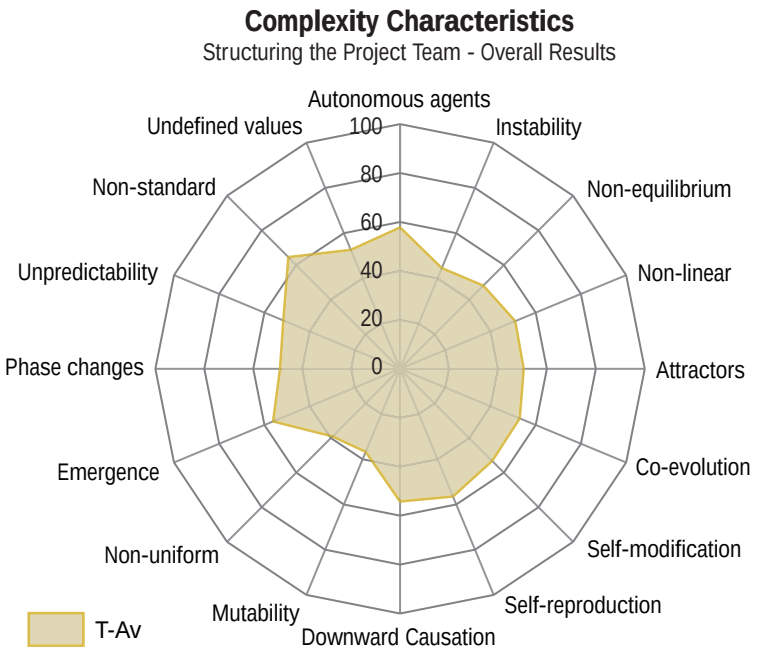

Figure 3. Overall results for current level of actions taken for managing the effect of complexity characteristics when structuring the project teams

Case study results

The five case studies / projects which were followed for two reporting periods covered the three phases of the project life cycle and progress was monitored weekly. PMs and their teams issued the progressed programme and indicated, on a standard proforma, the coded reasons for delay. The average percentage drop in performance for all five case studies is shown in Figure 4 and Table 5 provides a listing, by case study, of the most frequently occurring complexity characteristics which partly affected performance.

From Table 5 it can be seen that for the sub-process of structuring the project team the most frequent complexity characteristics that occurred and contributed to the drop in performance were:

For all five case studies	For four of the case studies	For three of the case studies
C3: Non-equilibrium	C2: Instability	D5: Mutability
D1: Co-evolution		D8: Phase changes

It should be noted that the sub-process of structuring project teams is not (and cannot be) implemented in isolation from other project management sub-processes, e.g. selection of team members, management style, monitoring and control and others. Therefore the exact percentage of the effect of complexity onto the project performance, through the sub-process of structuring project teams, although identified by the PMs and their teams it cannot be isolated.

Analysis of results

Responses in terms of the prevailing conditions provided feedback which actually represents the changes that have occurred in construction for the last decade since the Latham and Egan reports. That is, an environment which is becoming friendlier but which remains dynamic and complex.

The responses to the postal questionnaires with regard to structuring the teams indicate that the majority of client PMs consider the structure only down to the team leaders (48%) whereas the majority of construction PMs down to supervisor level (47%) with a considerable percentage indicating structuring down to team member level. Surprisingly a high percentage (10%) indicated that the project structure is not defined. Respondents also

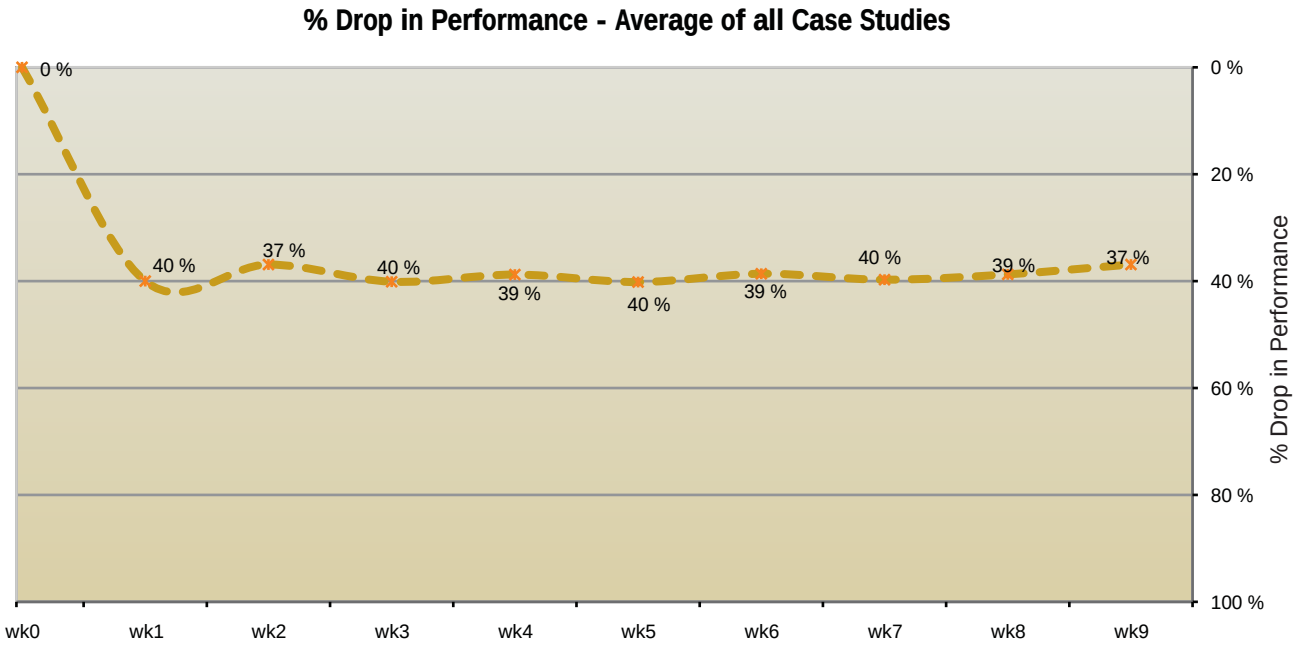

Figure 4. Average % performance drop for all case studies

indicated that the matrix structure is implemented at the discipline leader and design team levels whereas for the construction team the functional structure is used. It is worth noting that a considerable percentage indicated that they 'did not know' the type of structure implemented.

In terms of complexity, interviewees indicated that at company level structuring of project teams is not considered as source of complexity (see Figure 1), however at personal level, 'interfaces', the appropriateness of the 'organisational structure', 'people in fixed places', 'rigidity of structure' where considered as sources of complexity (see Figure 2). This in fact contradicts questionnaire responses where structures used do not provide characteristics that will enable the management of complexity at source.

With regard to actions taken to manage the effects of complexity characteristics onto the sub-process of structuring the teams, interviewees indicated that a mediocre level of actions is taken (depicted in Figure 3).

The lack of a structured approach, either by defining or providing tools, for managing complexity is evident from the interviews and this is shown clearly in the below average level of actions taken.

Consequently, and as can be seen from the causes of delay in the case studies results, the lack of actions to manage complexity in the sub-process contributes to the dramatic performance drop of 40%. Comparing the results from the interviews against those of the case studies it can be seen that the most frequently occurring complexity characteristics, that cause delays and contribute to the drop in performance, are also those that have the lowest level of actions taken to prevent / manage their effect. Therefore the results confirm the research question raised and the direct link between the sub-process of structuring the team and the management of complexity.

Proposed complexity management framework

Complexity needs to be approached in a more structured way. A simple plan of action will need to be established that will enable PM practitioners to manage its effects. The following points are proposed as a plan of action:

1. Definition(s) of types of complexity;
2. Identification and understanding of the complexities to be dealt with;
3. Establishment of tools for managing complexity. Tools which will be used to identify actions that will mitigate complexity;
4. Monitoring of actions implemented; and
5. Continuous reviewing and improving and the status of actions and results for improving the outcome.

With regard to complexity of interconnections and in terms of the tools to be used (item 3), a simple framework can be developed for each project management process which, by using the complexity characteristics, will identify required action(s). It will also allow the PM practitioners to identify the level of managing its effects continuously, provide guidance for follow-up action(s) and allow for orderly actions to be taken that will support the monitoring, reviewing and improvement steps. In addition the tool will have to be flexible and allow for varying management style and types of projects. The holistic approach will enable practitioners to be more innovative and straight forward in terms of handling the effects of complexity of interconnections onto projects through each project management process.

Discussion

The analysis of results indicates that despite calls for flexible, self-organised and empowered team structures, which are more suitable for the dynamic and complex construction environment, the industry continues to employ unsuitable and dated structures. PM practitioners define the structure only to a team leader / supervisor level and not to the lowest team level. As a result the importance, influence and criticality of the project structure especially in the boundaries formed when project teams come together to deliver a project, are not considered.

Phase	Case study	Structuring the Team
Construction	G1.1.2	Instability (C2)
		Non-equilibrium (C3)
		Co-evolution (D1)
		Downward Causation (D4)
		Mutability (D5)
		Phase Changes (D8)
	G1.1.4	Instability (C2)
		Non-equilibrium (C3)
		Co-evolution (D1)
		Downward Causation (D4)
		Mutability (D5)
		Phase Changes (D8)
	G2.1	Instability (C2)
		Non-equilibrium (C3)
		Co-evolution (D1)
		Mutability (D5)
		Phase Changes (D8)
Design	G1.3	Instability (C2)
		Non-equilibrium (C3)
		Co-evolution (D1)
Commissioning	G1.2	Non-equilibrium (C3)
		Attractors (C5)
		Co-evolution (D1)

Table 5. Complexity characteristics causing delay

In a friendlier but more dynamic environment, where both clients and contractors cooperate from the early project stage, utilising more transformational structures is feasible and achievable

From the review it is obvious that the evanescent nature of projects and the interconnections created when teams come together will cause complexity. Although the theoretical background has been established and techniques for structuring teams at the lowest levels exist all these are not channelled through to the management of projects in a manner which will enable the management of the effects of complexity.

Therefore the potential exists whereby utilising the understanding of complexity created by the interconnections and its characteristics and implementing existing techniques a framework can be developed with which to manage the effects of complexity for the sub-process investigated.

Conclusion

The investigation into the sub-process of structuring project team members and the consideration of complexity characteristics by practitioners in order to mitigate complexity of interconnection, established that neither are implemented in construction projects. Results established the direct link between the sub-process and complexity and confirmed that establishment and management of complexity is limited to within a number of control mechanisms which have been created by the construction industry.

Practitioners require distinct alternatives that will enable them to move away from the stereotypical forms of structuring project teams, as well as provide them with greater understanding of complexity and in particular that of interconnections.

Having linked the complexity characteristics to construction and in particular to the sub-process of structuring project teams, it is of interest to all involved to establish plans and implement actions which will enable the management of the effects of complexity on a number of project management sub-processes.

In a friendlier but more dynamic environment, where both clients and contractors cooperate from the early project stage, utilising more transformational structures is feasible and achievable. Also in a more complex environment the implementation of a framework of actions will enable the management of the effects of complexity characteristics to the benefit of the project performance.

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The 4e Risk Model (4^E)

Project Managing the Value System

Comprehensive international research into the value of project management identifies "fit" as the key determinant of value. The problem is that the necessary prerequisites for measuring fit and the dimensions of value have not yet been formally established. This article shows how a new management framework called The 4e Risk Model (4^E) provides one solution that can help managers to address this problem. Evidence from academic and empirical research into the practical application of this model by hundreds of companies shows how 4^E can be used to measuring fit and the dimensions of value using four success levers across sixteen value added areas – The Value System. 4^E is designed to provide decision makers with a framework that will help them to establish a value culture to ensure the long-term interests of the business and its key stakeholders are formally and adequately taken into account.

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This is an updated and edited version of a paper that was first time published in the proceedings of IPMA 2010 World Congress.

Stakeholder satisfaction as a critical success factor

Project Success is the level of appreciation by the various interested parties of the project outcomes (IPMA, 2006). Appreciation is quite a subjective measure as is the concept of value. International research into the value of project management confirms that fit is the key determinant of value (Thomas and Mullaly, 2008). Fit measures the degree to which a project management implementation provides what an organization needs, based on the context in which it operates and the value that it is trying to create. This is consistent with Michael E. Porter's definition of strategy as creating fit among a company's objectives (Porter, 1996). Therefore fit is not only the key determinant of value of project management activities it is also a key determinant of value at a strategic level.

The problem is that necessary prerequisites for determining fit and the dimensions of value have not yet been formally established. At best fit can be inferred by satisfaction – where a number of stakeholders from perspectives all express a strong degree of satisfaction, the likelihood of fit is higher (Thomas and Mullaly, 2008). The importance of the project sponsor's understanding of success is further emphasized in research defining project Critical Success Factor (CSF) frameworks. CSFs were developed on the basis that success is primarily stakeholder dependent (Turner, 2005). So measuring stakeholder satisfaction is fundamentally important for measuring fit and the dimensions of value. Yet both of these critical success factors are inherently subjective.

Measuring stakeholder satisfaction

It is arguable that objective measures such as timely delivery, within budget, to the required specification tell us nothing about the primary success factors – stakeholder satisfaction and appreciation. Perhaps the best test of project success, and the key to sustainable business growth, is client satisfaction. This dilemma takes project managers out of their area of expertise in planning and executing projects into the less familiar domain of economics. Therefore the focus of this model is a shift in metrics from the relatively "comfortable" management area of measuring outputs to the traditionally "frustrating" area of stakeholder behaviours and perceptions of outcomes. There is no better or simpler way to measure value than to ask our stakeholders (internal and external) how satisfied they are. The truth is that stakeholder satisfaction is the acid test of value creation yet we have very little guidance let alone tools and techniques to help us measure stakeholder appreciation.

The structure for The 4e Risk Model is designed to address these challenges by measuring value in terms of stakeholder satisfaction. The first element of The 4e Risk Model is a Value Map that combines Success Levers on the horizontal axis with Value Levels on the vertical axis as illustrated in Figure 1. There are four typical Value Levels in project organizations: portfolio; programme; project and operations.

The 4e Value Map is a framework for measuring the outcomes of a company's Value System through which managers create and deliver business benefits. Each cell in the map contains tailored questions that test the level of appreciation among project stakeholders of that area within the Value System. The measure of value added in each area of this Value System is achieved through consensus from stakeholders. For example if a majority strongly agrees that budgets are well

managed then that is a measure of appreciation on that value added area. Objective evidence is required to support this subjective assessment in each value added area.

Evolution of the 4e Risk Model

Asking good questions is a powerful way to focus on what matters. One of the best questions ever asked at one of our project steering group meetings was "where are we?" As we argued about whether this referred to design development, cost control or progress on plan, we realized that the question also encompassed efficiencies, earned value, stakeholder agreements, and funding draw-down. These questions are complex and interdependent. What we needed was a framework to measure "where are we?"; "where should we be?" and "how much is sufficient?" in each of these areas.

Inspired by the simplicity and utility of the four step Plan-Do-Check-Act Cycle for optimizing the quality control process (Deming, 1952), the author has developed a pragmatic framework for optimizing the risk management process. Project managers operate in a creative and chaotic system that we must control to achieve our objectives. Searching for examples of consistently successful management tools to manage unstable / chaotic conditions we find further inspiration from the Wright Brothers who invented the four control surfaces to stabilize flight and the Chinese who invented the four points of the compass for navigation and direction-finding.

What if there is a similar "fourmula" (four point framework) that project managers could rely on to help them direct and manage their projects successfully through uncertainty?

Evidence from seven years of empirical and academic research by the author into management success strategies indicated that successful project management systems can be distilled into four Success Levers. Two hundred and fifty five success recommendations from 23 respected international management standards, texts and guidelines can be mapped relatively evenly across four categories of recommendations (Murphy, 2009).

- Efficient people - 26.3%
- Effective processes - 26.6%
- Economical costs - 19.3%
- Expected benefits - 27.8%

These are the 4e's. Further studies by the author into failure factors identified that we must include a balanced coverage of all four levers if we are to create the conditions for success. Surprisingly even some of the most recent management success guidelines omit one or more of these levers as outlined below – gaps in best practice.

The Value System

The Golden Rule is actually the value-system within which decisions have to be made... in its entirety it constitutes an ethical system. Drucker (1955)

Contemporary evidence demonstrates that dysfunctional alignment with a limited number of business objectives in the banking sector can destroy value on a global scale. The ethical imperative is therefore central to this new 4^E methodology. According to Peter Drucker the most successful companies know and manage the costs of the entire economic chain rather than its costs alone. The Value Chain Model proposed by Michael Porter (1985) went some way toward measuring the Value System, yet Porter's model falls short of the 4^E success lever criteria since there is no explicit economy lever in that model.

Not everyone might agree with this analysis of Porter's value Chain model. Indeed some may argue that Porter identified ten cost drivers within the system. However when combined with the results of a similar test of other models as summarized below, it is difficult to dispute the strategic importance of all four Success Levers being explicit in management models and guidelines.

4^E		Success Levers			
		Efficient People (e1)	**Effective Process** (e2)	**Economical Costs** (e3)	**Expected Benefits** (e4)
Value Levels	**Portfolio** Value Innovation (v1)	Capability	Priorities	Funding	Strategy
	Programme Value Management (v2)	Allocation	Plans	Business Case	Stakeholders
	Project Value Engineering (v3)	Accountability	Implementation	Budgets	Ethics
	Operations Value Improvement (v4)	Productivity	Governance	Value for Money	Sustainability

Figure 1. The 4e Value Map

4E identifies gaps in best practice

The gap in Porters Value Chain Model is one of many gaps when this 4E test is applied. Further gaps are found in the European Foundation for Quality Management Model (EFQM, 1994) which also omits the economy lever in its framework and in doing so neglects funding, business model, budgets, and value for money CSFs. The Handbook for Project Management (Turner, 1999) omits the process effectiveness lever in his criteria for judging success and therefore neglects to include CSFs such as prioritization, planning, implementation and governance values. The Risk Management Standard BS6079:2000 omits the efficiency lever which encompasses capabilities, allocations, accountability and productivity (this Standard is now superseded by ISO 31000:2009 – which itself also appears to fall short). The vital expenditure lever is omitted by each of the following publications: Value Management Standard BSEN 12793:2000, Management of Risk Guidance for Practitioners M_o_R (OGC, 2002), Meredeth and Mandel (2004), and even ISO31000 (2009). Kerzner and Salidas who propose four cornerstones for success in Value-Driven Project Management (2009) omit both effectiveness and economy levers.

The conclusion here is that key components of the Value System have clearly not been quite so obvious from traditional management guidelines.

By contrast recommendations that include at least one of all four levers include: Value and Risk Management (Dallas 2006), Val IT (2006), APM Body of Knowledge (2006), Kerzner sixteen points for project management maturity (2005), PRINCE2 (2005), Gray and Larson (2005), PMBOK® (2004), IRM drivers of key risks (2002), Value Drivers for Good Design OGC (2004), Turner Seven Forces Model for project based management (2000), Turner five principles of good management (1999), The Balanced Scorecard (Kaplan and Norton, 1992), and Project success factors (Pinto and Slevin 1988).

Results from the author's research show that all four Success Levers must be applied in a balanced and appropriate way across the entire Value System to create the optimum conditions for success.

4E		Success Levers			
		(e1)	(e2)	(e3)	(e4)
Value Levels	(v1)	(g2) Planning Quadrant		(g1) Strategy Quadrant	
	(v2)				
	(v3)	(g3) Implementation Quadrant		(g4) Growth Quadrant	
	(v4)				

Figure 2. The 4e Growth Drivers

How 4E measures fit and the dimensions of value

The 4e Risk Model uses bespoke semi-quantitative scores to test the level of stakeholder satisfaction of value added outcomes. Some may argue against the use of precise scores to measure intangible things like appreciation. But this is an indicator not a precise score. The semi-quantitative scoring approach is consistent with the Competence Self Assessment Methodology (APM, 2008), the APM Body of Knowledge (2006), and the ICB-IPMA Competence Baseline (2006).

The 4e Risk Model measures value across five dimensions:

- Success Levers
- Value Levels
- Capability Layers
- Growth Drivers
- Maturity Profile

The dynamics of the 4e Value Map are indicated in Figure 2. Strategy drives planning which drives implementation which drives growth. And the cycle continues with inevitable changes in strategy as the organization responds to changes in the competitive environment. Strategy and Growth domains incorporate the principle business risks and objectives from social and environmental issues. The Value Map helps managers to assess how well these are taken into account in their own company. While strategic objectives may change frequently, implementation of these objectives is always driven by the four Success Levers. Within the Value System there are three competing factors in each domain:

- g1: Customers, funding & competitors
- g2: Internal capabilities, process & technologies
- g3: The Triple Constraint Triangle
- g4: The Triple Bottom Line

It is clear from discussions with leaders in the PMI, APM, IPMA and others that the discipline of project management needs to expand its focus from Implementation and Planning domains to address the challenges of Strategic and Growth domains. This will help the profession to ensure that it can take the lead in project managing company Value Systems to optimize the delivery of business benefits. 4E is designed to help the profession to achieve that objective – in any business sector.

Benefits of 4E

The 4e Risk Model provides a measurement framework for determining fit and the dimensions of value from project management initiatives. This helps the project management and wider management communities to establish a value management culture at all levels to ensure that long-term interests of all stakeholders are taken into account. Specific benefits of implementing The 4e Risk Model include

- Identifying the prevailing Value System priorities throughout the company
- Assessing outcomes of stakeholder behaviour and performance
- Assessing and developing managers ability to communicate objectives clearly

- Building consensus and commitment to common values and objectives
- Identifying and improving value creation at all levels of the organization
- Developing managers ability to identify opportunities for improving competitive advantage

Application

Tangible benefits reported from a variety of companies who used The 4e Risk Model include:

- Cost savings: Risk management staff applied this approach and created six-figure savings and a demonstrable improvement across the Value System of 16% over twelve months in that organization.
- Most economically advantageous procurement decision: A multi-criteria options framework was developed to formalize and optimize procurement decisions in the financial services sector.
- Community of Practice Risk Assessment: A health check and benchmarking exercise among the companies of an Operational Excellence Working Group in the Pharmaceutical Sector. CSFs of leading companies were shared with the community
- Staff productivity risk workshop: A leading international consulting engineering firm used 4e Risk Model to compare the amount of time spent pro-actively managing risks as compared to reactive management for each of the four risk levers.
- Benchmark risk management maturity levels: Comparing The Value System Scores of a range of industries including IT, construction, financial services, pharmaceutical, aerospace & defence.
- Misaligned objectives: When directors and managers answered the same questions separately – significant differences were found. This helped clarify assumptions, objectives and communication issues.

Conclusions

The 4e Risk Model provides a new framework for measuring Critical Success Factors such as stakeholder appreciation and satisfaction. This helps decision makers to establish a value management culture at all levels in their organizations to ensure that long-term interests of all stakeholders are taken into account. 4^E is designed to support decision makers in optimizing the delivery of their business benefits.

For more details or to participate in ongoing empirical research into The 4e Risk Model contact the author at info@4eriskmodel.ie

Case Study

Comparing the Value Systems of two Pharmaceutical Companies

Results from the authors empirical research into the Value Systems of two pharmaceutical companies are compared and contrasted below. These companies were selected to highlight relative strengths and weaknesses between two competing companies of similar size, complexity, and turnover.

4^E	e1	e2	e3	e4
v1	?	G	?	?
v2	?	R	?	R
v3	G	R	?	G
v4	R	R	?	?

Figure 3. Value Map PharmaCo#1

4^E	e1	e2	e3	e4
v1	G	G	G	G
v2	G	?	G	G
v3	G	G	G	G
v4	R	G	G	G

Figure 4. Value Map PharmaCo#2

The 4e Risk Model incorporates 32 carefully tailored questions designed to test all levels of the Value System. The red, yellow and green colours in the Value Maps indicate the measure of stakeholder satisfaction in each value added area. For example in the Capability Cell (e1.v1) the statement is "Are key skills and corporate knowledge fully utilized to maximize our competitive advantage?" Strong stakeholder disagreement is shown in red shading; don't know response in yellow shading; and agreement is shown in green shading on the Value Map. The red cells results within the Value Map of PharmaCo. #1 indicate satisfaction ratings across the Value System are quite low particularly in relation to efficiency and effectiveness levers. The benefits of this Value Map are that it clearly identifies key internal weaknesses (red cells); key internal strengths (green cells); communication gaps across the organization (yellow cells); and competitive strengths and weaknesses. The Value Map can be readily applied to compare performance between projects or departments within an individual company, or to test the perceptions of different stakeholders in each area, or to establish a reward system to encourage improvements in any or all value added areas.

Compass Charts

The 4e Risk Model uses Compass Charts (Figures 5 and 6) to help diagnose the causes of the satisfaction ratings that are identified on the Value Map.

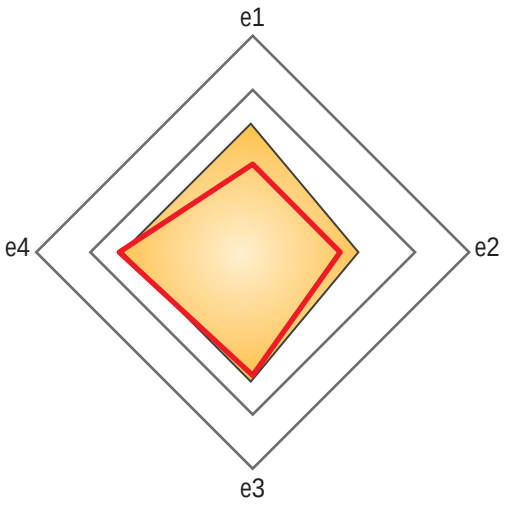

Figure 5. Success Lever Compass PharmaCo#1

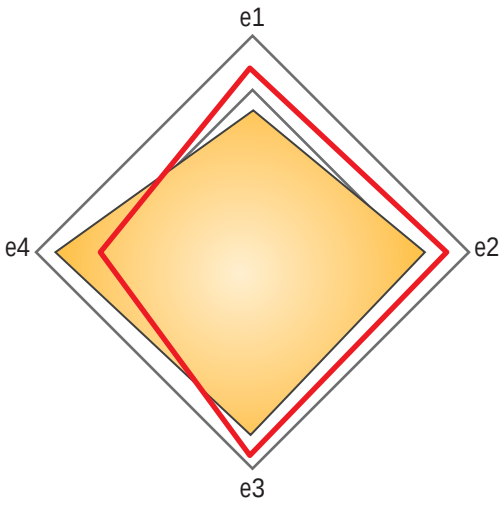

Figure 6. Success Lever Compass PharmaCo#2

The outer boundary of each compass represents the maximum satisfaction score on each axis. The red line shows the level of stakeholder satisfaction with the outcomes of project level / business unit decisions. The blue diamond shows the level of stakeholder satisfaction with the outcomes of corresponding corporate decisions. Current management priorities (leading objectives) are identified by the top level of satisfaction in each compass. This may be at the expense of other priority areas (lagging objectives). The Compass also clarifies where corporate and project objectives are misaligned.

4^E Risk Maturity Profile

Figure 7 shows the results of the fifth dimension of The 4e Risk Model - the Maturity Profile. This is a graph showing the results of a process control audit to test the level of maturity in each value added area. While each compass "points to" the causes of Value Map strengths and weaknesses, the Maturity Profile provides a "route map" to improved corporate performance.

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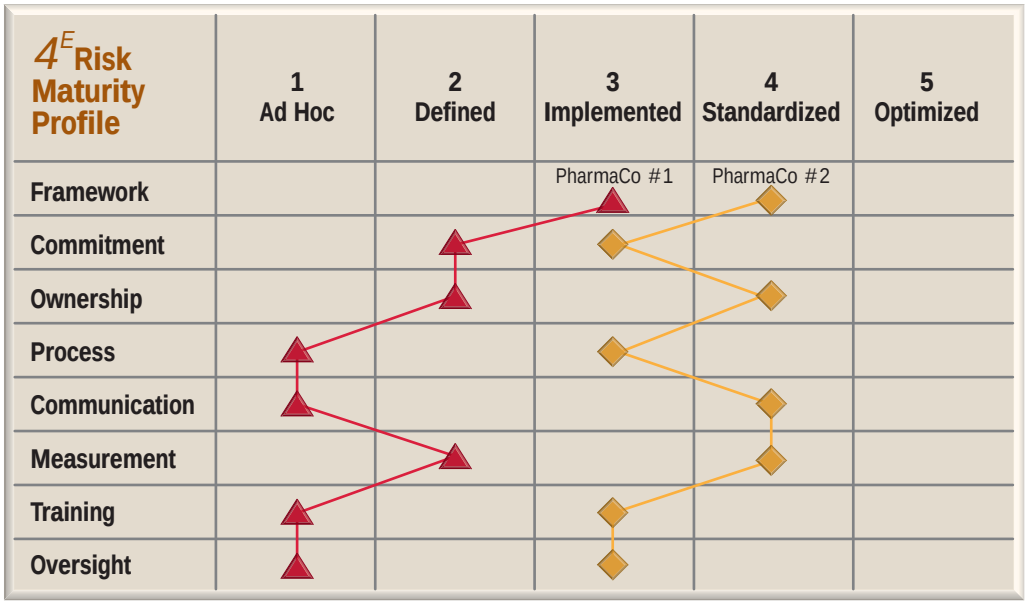

Figure 7. The 4e Risk Map - Maturity Profile Comparison: PharmaCo #1 & PharmaCo #2

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He developed the concept for The 4e Risk Model during his MBA thesis research in 2004. Since that time he has been testing, refining and validating the model through his own practice and through pilot testing with the cooperation of dozens of Project Management Masters students from all sectors and industries.

International Strategic Alliances in Construction:

Performances of Turkish Contracting Firms

Firms need various resources and capabilities in order to compete with each other effectively. These resources and capabilities can be acquired, developed internally, or obtained via an ongoing cooperative relationship with another firm through the use of a strategic alliance. The use of strategic alliances in construction industry has increased sharply over the last decade and they are particularly effective in helping a firm maintain a superior competitive position in dynamic environments. Alliances reportedly improve the competitiveness of the construction firms by providing access to external resources, by providing synergies and by fostering rapid learning and change. The purpose of this research is to identify the success factors and key components of the development process of strategic alliances, and propose a process model of strategic alliances performances based on alliance conditions in international construction industry. The research involves a questionnaire survey conducted to the Turkish contracting firms operating internationally. Different types of projects constructed by Turkish contractors in Commonwealth of Independent States, Middle East Countries, African Countries, and other regions of the world between 2002 and 2009, were analyzed and used in the developments made in this study. The results indicate that shared risk, trust between parties, and equity are found to be the most important determinants of strategic alliance success. The research findings support the contracting firms enhancing their productive capacities and acquiring competitive advantages that enable them to increase alliance performances. The study also commences on how the identified factors enhance the effectiveness of the participating firms' competitive strategies by providing for mutual resource exchanges (technologies, skills, or products).

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Introduction

The globalization of the construction industry is rendering the familiar model of a single firm doing all things in-house outdated. The technological, sharing sources (workmanship, machinery, equipment, etc.), political, financial and competitive capabilities that are required to operate in the global construction market means that firms need to establish alliances with other participants in order to survive. Alliances are defined as voluntary arrangements between firms involving exchange, sharing or co-development of products, technologies or services (Gulati, 1998; Ngowi, 2007).

In the construction industry, alliance organizations are employed when parties that are involved in similar activities, such as contractors joining forces to leverage their complimentary capabilities to carry out work. This occurs in situations where risks are too high for subcontracting to be viable. The cooperative aspect arises from the fact that each firm needs access to the other firm's know-how and that the firms can collectively use their knowledge to produce something that is beneficial to them all (common benefits).

The competitive aspect is a consequence of each firm's attempt to also use its partner's know-how for private gains, and of the possibility that significantly greater benefits might accrue to the firm that finishes learning from its partner before the latter can do the same (Khanna et al., 1998). Interfirm collaborations, such as strategic alliances, have become important business management instruments to improve the competitiveness of firms, especially in complex and turbulent environments. Alliances help to bridge the gap between the firm's present resources and its expected future requirements (Eisenhardt and Schoonhoven, 1996). In this time of globalization and radical technological change, alliances have become important strategic manoeuvres in construction industry.

Turkish contracting firms are open to international partnerships, not only in the field of contracting but also in construction industry investments, ranging from the manufacturing of construction materials to infrastructure, housing, industry and tourism. Extensive know-how and experience gained through working abroad for nearly four decades in all kinds of challenging engineering projects and in all forms of business environment are among their distinctive strengths. Turkish contracting firms are now exploring the significant needs of the products and services of the countries in which they are operating or intending to operate. They are catering to those needs with whole package offers consisting of basic or process engineering, feasibility studies, equipment selection and extension of credit. The present share of the Turkish construction sector

in the international market is about 10% and today, Turkish contractors play a major role in the international arena and are active in more than 25 countries.

The experience gained in the Middle East and Common-Wealth Independent States (CIS) carried the Turkish Contractors to an outstanding position in comparison with their competitors some additional advantages such as geographical proximity, low labor cost and high quality technical personnel make Turkish contractors noteworthy. The internal and external forces and factors that have contributed to this rapid development can be grouped under the following three categories: the attractiveness of business opportunities abroad; reduced business opportunities in Turkey; and the increasing competitiveness of Turkish contracting firms.

Further market diversification and specialization in certain types of projects were the major trends in this period. The number of countries in which Turkish contracting firms was working increased considerably, causing the percentage of work in each country to decrease relatively. In this period, significant progress was made in terms of the scope and size of projects being undertaken. Market, product and business diversification continued further, while several companies started to specialize in certain project types, such as international airports, railways and urban subway systems.

Firms need various resources and capabilities in order to compete with each other effectively. These resources and capabilities can be acquired, developed internally, or obtained via an ongoing cooperative relationship with another firm through the use of a strategic alliance. The use of strategic alliances in construction industry has increased sharply over the last decade and they are particularly effective in helping a firm maintain a superior competitive position in dynamic environments. Alliances reportedly improve the competitiveness of the construction firms by providing access to external resources, by providing synergies and by fostering rapid learning and change. The research focus is to 1) explore the key elements of the strategic alliance process 2) identify the potential success factors in strategic alliances, and 3) develop a conceptual framework of strategic alliance that would reflect more about the real practices of alliancing in international construction industry.

Strategic Alliances in Construction Industry

The ensuing globalization of the construction industry as well as the highly fragmented and divisive nature of the industry are among the forces that are influencing it to seek management approaches such as strategic alliances that could leverage the capabilities of the various participants (Ngowi, 2007). Strategically, organisations may enter into alliances (a form of partnership) in order to innovate, access new markets, overcome local market restrictions, raise entry barriers and share risk for mutual benefit (Stanek, 2004).

A strategic alliance is a cooperation with a duration longer than a project, which has the intention to change the product market competence combinations of the participating partners. These partners share the rewards and risks. They conscientiously create a level of mutual dependence and exclusivity, without losing their independency. Implicit rules of trust and equality apply to the mutual interaction and attitude (Snijders and Geraedts, 2007). Alliancing is generally assumed to be a long-term business strategy linking together client, contractor and supply chain (Rowlinson and Cheung, 2004). Alliance partners are brought together for a specific outcome or project, where risks and rewards are jointly shared and there is goal alignment between parties. Alliance between firms that are engaged in similar activities has both cooperative and competitive aspects. While the former enables the firms to leverage their complementary capabilities for common benefits, the latter tend to push the allied firms to engage in competitive racing in learning the capability of the partner(s) for private benefits (Ngowi, 2007; Khanna et al., 1998)

Research has documented numerous benefits that strategic alliances hold out for small firms, including the ability to tap into new markets, access scale economies, obtain complementary resources in under-developed value chain activities, respond to environmental uncertainties, and receive endorsements from reputable incumbents, among others (Arino et al., 2008; Deeds and Hill, 1996; Dickson and Weaver, 1997; D'Souza and McDougall, 1989; Eisenhardt and Schoonhoven, 1996; Gomes-Casseres, 1997; Hara and Kanai, 1994; Larson, 1991; Shan, 1990; Stuart et al., 1999).

Process of Strategic Alliancing

Strategic alliancing is typically characterised by a number of phases ranging from the selection of contract participants through to the completion of the correction period. There is a common premise in the management perspective of strategic alliance that the process should be composed of three stages (i.e., formation, implementation, and evaluation) (Buono 1997; Das and Teng, 1999).

In this study, the process of strategic alliance is composed of four stages unlike the past studies. These stages are Alliance Planning, Alliance Formation, Alliance Implementation, and Alliance Completion. Alliance Planning refers to strategy development and partner assessment. Strategy development involves studying the alliance's feasibility, objectives and rationale, focusing on the major issues and challenges and development of resource strategies for production, technology, and people. Partner assessment involves analyzing a potential partner's strengths and weaknesses, creating strategies for accommodating all partners' management styles, preparing appropriate partner selection criteria, understanding a partner's motives for joining the alliance and addressing resource capability gaps that may exist for a partner. Alliance Formation refers to an agreement, implicitly or explicitly, made by all key construction parties to establish an informal relationship for the purpose of accomplishing mutually agreed upon goals and objectives. During this stage, involved parties should prepare to diagnose their current practices and to address their concerns about what partnering can help

them to fill the performance gap. They may be required to unfreeze their mind to accept the needs for change when they accept the concept of partnering. Alliance Implementation refers to the execution of the informal relationship to accomplish the mutually agreed goals and objectives in line with the construction project. At this stage, alliancing is operating to exert its influence on the construction projects. It is a process to learn and experience the newly adopted concepts and practices derived from alliancing. Alliance Completion refers to the intention of the construction parties to rerun an informal relationship with the same group of firms for a new project after the completion of the current project. Most often, if construction parties aim at implementing alliancing for a single project, the alliancing team will be resolved after the project is completed.

Determinants of Strategic Alliance Performance

Multiple factors determine the performance outcome of strategic alliances, ranging from the nature of the industry and institutional environment, within which the alliance operates, to the quality and commitment of the alliance management. Successful alliancing requires creativity, trust, commitment, interdependence, cooperation, open communication, goal alignment and joint problem solving (Peters et al., 2001; Howarth et al., 1995; Hampson and Kwok 1997; Rowlinson and Cheung, 2004). Alliance structure is also a highly relevant factor in alliance performance. Parkhe (1993) reports that appropriate alliance structure curbs opportunistic behavior and leads to better alliance performance. Alliance structure serves the purpose of control in alliances, which is critical because of the shared nature of alliance governance (Das and Teng, 1999).

Collaboration between alliance partners is essential for a successful alliance project. During collaborations, alliance partners are able to share resources including professional expertise; this initiates a higher frequency of ideas flow – after all, two heads are better than one. Alliancing will not succeed without continuous flow of information and communication. Through open and honest communication, foreseeable risks are exposed and parties have a better understanding of each other's needs. Trust, continuous open communication and knowledge sharing are the keys to successful alliancing (Rowlinson and Cheung, 2004).

During the life of alliances, the internal and external circumstances may change, often in unexpected ways (in the construction industry circumstances continuously change). How partners adapt to these changing circumstances determines whether an alliance prospers or flounders (Kraar, 1989; Ngowi, 2007). Successful adaptation of these changes calls for a delicate balance between

No	Factors	Source
1	Mutual goals & objectives	Green and Lenard (1999); Haque et al. (2004); Jefferies et al. (2006)
2	Tight alliance outline	Elliot (1998); Abrahams and Cullen (1998)
3	Alliance structure	Abrahams and Cullen (1998); Haque et al. (2004)
4	Commercial incentives	Abrahams and Cullen (1998); Haque et al. (2004); Jefferies et al. (2006)
5	Stretch targets	Green and Lenard (1999); Haque et al. (2004); Jefferies et al. (2006)
6	Partnering experience	Cheng and Li (2002), Black et al. (2000); Wu et al. (2009); Nielsen (2003)
7	Open communication	Haque, Green and Keogh (2004); Cheng and Li (2002)
8	Trust Between Parties	Elliot (1998); Green and Lenard (1999); Haque et al. (2004)
9	Flexibility & adaptability	Elliot (1998); Jefferies et al. (2006)
10	Shared risk	Bennett and Jayes (1995)
11	Adequate resources	Cheng and Li (2002)
12	Equity	Green and Lenard (1999); Haque et al. (2004)
13	Cooperative spirit	Elliot (1998); Abrahams and Cullen (1998); Haque et al. (2004)
14	Facilitation	Abrahams and Cullen (1998); Haque et al. (2004); Jefferies et al. (2006)
15	Sound relationship	Elliot (1998); Abrahams and Cullen (1998)
16	Best people for project	Abrahams and Cullen (1998); Haque et al. (2004)
17	Strong Commitment by senior management	Elliot (1998); Green and Lenard (1999); Abrahams and Cullen (1998); Haque et al. (2004); Jefferies et al. (2006)
18	Good cultural fit	Black, Akintoye, and Fitzgerald (2000)
19	Joint process evaluation	Green and Lenard (1999); Abrahams and Cullen (1998)
20	Shared knowledge	Abrahams and Cullen (1998); Haque et al. (2004)
21	Dispute resolution process	Green and Lenard (1999)
22	Continuous improvement	Larson (1991)

Table 1. List of Alliance Success Factors and Sources

the twin virtues of reliability and flexibility. Flexibility is necessary for partners to have a viable relationship in the face of changing circumstances, yet unlimited flexibility affords companies the opportunity and incentive to cheat, reducing the reliance partners can place on each other (Heide and Milner, 1992; Ngowi, 2007). Black et al. (2000) indicated that partnering experience is a critical factor toward partnering success. Firms learn and experience the newly adopted concepts and practices derived from partnering application. Wu et al. (2009) report that previous alliance experiences is a significant criteria of strategic partner selection process. Firms with experience in international strategic alliance activities may place more value on a partner with potential for development of new technology/knowledge and learning (Nielsen, 2003).

A number of researchers gathered lists of factors that are considered to be influential upon the success of strategic alliances. Table 1 summarises the literature of key success factors for strategic alliances.

Research Method

Sampling

A list of contracting firms within the construction sector operating internationally was obtained from the Turkish Contractors Association (TCA). The list consisted of 185 member organizations. The sample includes relatively medium to large companies. Company size is determined by the number of professional staff, number of construction projects per year, and the size of a typical project in US dollars. A company with more than 750-1000 employees is defined as large – 75 percent were large size companies. The numbers of international projects per year ranged from 5 to 20 projects, 60 percent were involved 5 to 10 projects. Project size ranged $1.5 million to $50 million (80 percent) and to over $100 million (20 percent). Distribution of international projects by type of work is shared by building construction (32%), transportation (36%), energy (12%), hydraulic works (7%), infrastructure (6%), industrial plant (5%) and other (2%). Major regions for projects undertaken by Turkish contractors abroad were Commonwealth of Independent States, Middle East Countries and African Countries. In this study, small size companies were not taken into consideration and kept out of the survey as they are not included in the TCA main list.

Data Collection

The empirical data was collected through a questionnaire survey, which was administered to the firms registered to the TCA. During the survey, all these firms operating internationally (185 member organizations) were contacted and asked to participate in the study. They were then fully informed of the research objectives, that the research was a strictly scientific and confidential and that their anonymity was assured. A total of 135 completed questionnaires were received, giving a high response rate of 73 per cent indicating that the sampling procedure was effective and that the respondents perceived the research to be relevant and worthwhile. The respondents were asked to rate the extent to of agreement with each statement based on a five point Likert scale of 0 (No effect) to 4 (Maximum effect). Contact personnel in the companies for the questionnaire survey were either the top management or senior management in their respective departments, therefore their level of knowledge expected to provide responses was acceptable for the purpose of validity of the survey results.

The questionnaire survey consisted of 22 statements. The questionnaire covers general information about the initiatives (owners, developers, contracting firms), alliance conditions and alliance development, partnering criterion and key success factors, partnering experiences, and the nature of the benefits accrued.

Findings

The participating contracting firms provided numerical scoring expressing their opinions on the significance of each factor. The weighted average for each factor was calculated and then it was divided by the upper scale of the measurements in what is referred to as "importance index" therefore the level of important of the factors categorized into four processes of strategic alliance development were calculated using the formula (Kish, 1965):

Level of Importance (Index) = [Σ(aX). 100] / 4

a= the score given to the factor by each organization (varying from 0-4)

X= n/N

n= Frequency of organizations

N= Total number of participant organizations

Table 2 shows a matrix of variations in level of important indices of the factors for determining the success factors and key components of the development process of strategic alliances. The X-axis of the matrix indicates the processes of strategic alliance classified into four categories as Planning, Formation, Implementation, and Completion. The Alliance Success factors were listed in the Y-axis of the matrix with their index values. The matrix also includes the calculated mean of importance indices and the rank orders of all the processes of strategic alliance listed at the bottom of X-axis with their index values. Studying the matrix the factors carrying the highest level of importance are mostly from the process Planning. These factors are "Shared Risk", "Trust between parties", and "Equity". In observing the highest ranked process, Planning carries the highest level of importance.

Discussion of the Survey

The factor "Shared risk" is ranked #1 and is perceived by respondents to have influence on all the alliance processes with a value of importance index 71,25. The interviews and observations highlighted that alliance partners are brought together for a specific outcome or project, where risks and rewards are jointly shared. The findings are in congruence with the literature (Walker and Hampson, 2003, Peters et al., 2001). Through open and honest communication, foreseeable risks are exposed and

			Processes			
Rank	**MIP**	**Factors**	**Planning**	**Formation**	**Implementation**	**Completion**
6	3,07	Adequate resources	57,00	57,00	42,75	57,00
11	1,75	Tight alliance outline	28,50	28,50	28,50	28,50
4	3,73	Alliance structure	71,25	57,00	57,00	57,00
7	2,85	Commercial incentives	57,00	42,75	42,75	42,75
15	0,88	Stretch targets	14,25	14,25	14,25	14,25
4	3,73	Partnering experience	71,25	57,00	57,00	57,00
10	1,97	Open communication	42,75	28,50	28,50	28,50
2	4,17	Trust Between Parties	71,25	71,25	71,25	57,00
13	1,32	Flexibility & adaptability	28,50	28,50	14,25	14,25
1	4,38	Shared risk	71,25	71,25	71,25	71,25
8	2,63	Mutual goals & objectives	42,75	42,75	42,75	42,75
3	3,95	Equity	71,25	71,25	57,00	57,00
13	1,32	Cooperative spirit	28,50	28,50	14,25	14,25
14	1,1	Facilitation	28,50	14,25	14,25	14,25
9	2,41	Sound relationship	42,75	42,75	42,75	28,50
15	0,88	Best people for project	14,25	14,25	14,25	14,25
16	0,66	Strong Commitment by senior management	14,25	14,25	14,25	0
5	3,51	Good cultural fit	57,00	57,00	57,00	57,00
12	1,53	Joint process evaluation	28,50	28,50	28,50	14,25
8	2,63	Shared knowledge	42,75	42,75	42,75	42,75
17	0,44	Dispute resolution process	0	0	14,25	14,25
18	0,22	Continuous improvement	0	0	0	14,25
		Mean Importance Index (MIP)	13,59	12,5	11,84	11,4
		Rank	1	2	3	4

Table 2. Matrix showing the Variations in the level of Importance Indices of the factors

parties have a better understanding of each other's needs. Under the alliance, all parties should take collective ownership of all risks associated with delivery of the project, with equitable sharing of risks using a risk/reward mechanism (Rowlinson and Cheung, 2005). The risk/reward mechanisms are to be adopted in the alliance project which will create financial incentives and equitable risk sharing between the alliance parties. By adopting a risk/reward mechanism, there are motivation incentives for all parties which encourage them to work towards "best for project" solutions.

The factor "Trust between parties" is ranked #2 and is perceived by respondents to have influence on the alliance processes Planning, Formation, Implementation with a value of importance index 71,25, and on the alliance process Completion with a value of importance index 57,00. The interviews and observations highlighted that trust between alliance partners creates an opportunity and willingness for further alignment (such as future job opportunities), reduces the need for continuous cross monitoring of one's behavior, reduces the need for formal controls and reduces the tensions created by short-term inequities. It allows the partners to focus on their long-term business development as well as cutting down cost and time outlays. The findings are consistent with the literature (Rowlinson and Cheung, 2005). Without trust, there would not be sharing of resources and knowledge; without trust, there would be hidden agendas and closed communication.

The factor "Equity" is ranked #3 and is perceived by respondents to have influence on the alliance processes Planning, and Formation, with a value of importance index 71,25, and on the alliance processses Implementation, and Completion, with a value of importance index 57,00. The interviews and observations highlighted that firms try to design alliances that are efficient and equitable at the time of the alliance's establishment. Alliances enhance the value of equity ownership ties between firms. Equity is an important ingredient in developing win-win thinking among parties. The findings reinforce the literature (Allen and Phillips, 2000; Chan et al., 2004; CII, 1991; Husted

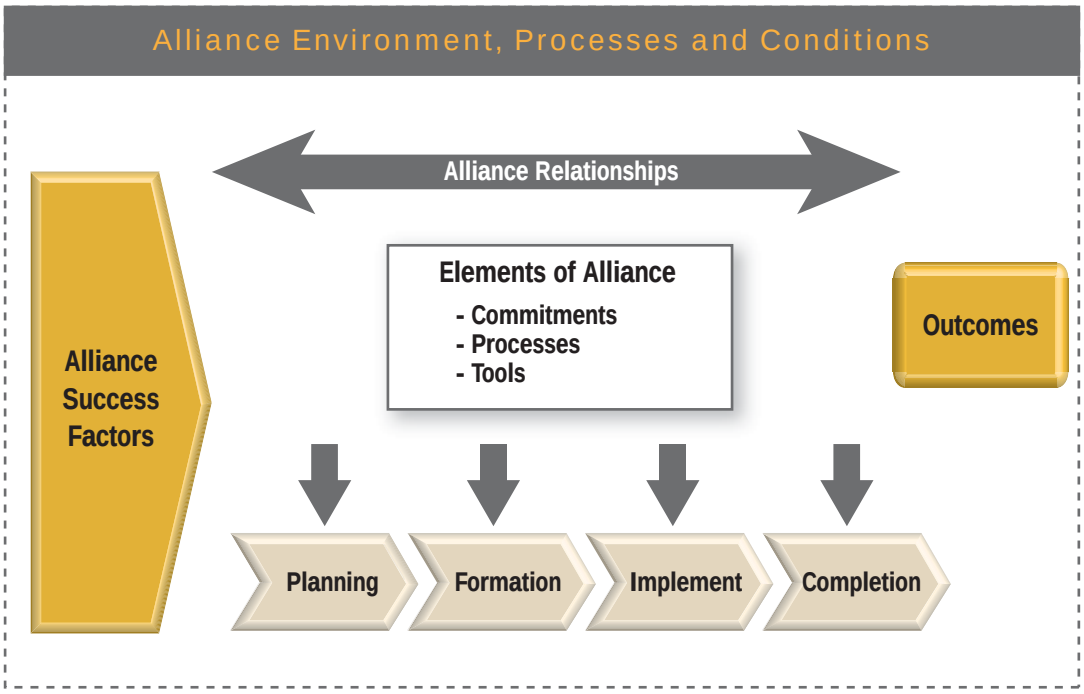

Figure 1. Model Framework of Strategic Alliance

and Folger, 2004). The development of an equitable relationship between the stakeholders has been found to be necessary as equity promotes mutual motivation when "win–win" solutions were sought rather than the "win–lose" solutions of traditional relationships.

As it is shown in Figure 1., the conceptual framework uses a four-stage process—planning, formation, application, and completion—which forms the basis for considering what factors lead to the success of each stage. In the proposed conceptual framework, it can be seen that the commitment, processes and tools criteria are considered to have the greatest bearing on the establishment and development of the alliance relationship. Successful outcomes of individual projects involving the use of strategic alliance are likely to generate shared rewards and benefits and create an opportunity for the organizations to share risk, develop and build trust and equity between parties, maintain alliance structure, good cultural fit, and achieve joint learning from the experiences. These outcomes act as feedback to the process further strengthening the role of each element and benefit the relationship development process overall.

The research findings support the contracting firms enhancing their productive capacities and acquiring competitive advantages that enable them to increase alliance performances. Shared resource exchanges (technologies, skills, or products) between the parties enhance the effectiveness of the participating firms' competitive strategies. In strategic alliances, having a common strategic direction helps firms to have a better understanding of their mutual goals and expectations. Alliance structures should include a learning framework enabling open reflection of partners' knowledge whilst retaining visions and individualism. This allows all parties to benefit from shared knowledge.

Conclusion and Recommendations

This paper presents a survey study for determining the strategic alliances'performances of Turkish contracting firms operating internationally. The success factors and key components of the development process of strategic alliances were identified and a process model of strategic alliances performances based on alliance conditions in international construction industry was proposed. It was found that "Shared risk", "Trust between parties", and "Equity" are found to be the most important determinants of strategic alliance success and Planning and Formation are the two processes which the interviewees believed would highly be influenced by the success factors mentioned above.

Managers of contracting firms can reduce the risk of alliance failure and can generate more value from their alliances by studying the detailed critical success factors. Process and content issues are equally important for alliance success. Alliance competence, i.e. knowledge of how to forge and manage alliances, could provide contracting firms with the capability to protect their independence while surviving in a tide of globalisation and rapid technological change.

Successful alliance operations require enormous inputs of physical and intangible resources: management skills, production technologies, employee motivation, adaptiveness, innovativeness, and the partners'capacities to set aside direct pursuit of their individual business interests while sharing both the benefits and risks of collaboration. The shared interests of the partners in the alliance create goal alignment which minimizes opportunism, and there is a mutual hostage situation as both partners have made substantial investments and are dependent on each other's performance. These features assist in managing relational risk. As cooperation and competition coexist between

alliance partners, cooperative relationship evolves over time as partners learn more about each other's motives, capabilities and attitudes toward control, conflict, cooperation and competition. During this period, and the entire life of the alliance the partners are vulnerable in the various ways. Thus, in successful alliances, trust is often touted as a prerequisite, a necessity, and an absolute must.

The challenge for the strategic alliances is minimizing the polarization of construction industry in a global environment. Furthermore, this kind of organizations provide a trigger effect for the contribution of mutual strategy between the developed and developing construction industries through the world.

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Developing Collaborative Contracting – **Three Railway Project Cases**

Collaborative contracting models are often associated with a set of tools and techniques to manage relationships, but the efficiency of such formalization in changing project culture has been doubted. Further, although many projects are successful, collaboration often is more limited than policies and guidelines suggest. In this paper, we view partnering practice as a learning process related to a management innovation and analyse how collaboration practice develops in three major railway projects, all using the same partnering model. We find that partnering is easy to introduce due to the flexibility and adaptability of the concept, but that practitioners prefer to keep collaboration informal and groups small. Also, tangible benefits can often be reached with basic and common-sense approaches. When ambitions and complexity increase, however, more sophisticated relationship management becomes inevitable, calling also for integration with core project processes. Yet, partnering tools and systems do not seem to provide much guidance when it comes to organizing such complex multiparty collaboration. Careful attention to organizational issues in early phases is important both to appreciate the full potential of collaboration in the individual project and to promote industry level learning.

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Introduction

In the past years, both clients and contractors have expressed significant dissatisfaction with the way many Swedish infrastructure projects have been procured and managed. Insufficient risk allocation has resulted in high cost overruns and lawsuits, impacting on contractors' interest in submitting bids for major projects with high risks. In 2003, an industry-wide collaborative initiative was established by major government sector clients to promote efficiency and learning in the infrastructure sector (www.fiasverige.se). An important part of this initiative has been to encourage more collaborative contracting models for infrastructure projects and a general model, Increased Cooperation (IC), has been developed to guide project managers. The Swedish government sector clients for road and railway construction decided that their projects should normally apply the principles of Increased Cooperation and the recently (2010) established Swedish Transport Administration continues this policy. However, although government infrastructure clients have been working according to IC principles since around 2006, there is little information to date about how the model is applied in practice and the experiences from using it.

In most European countries, the need to improve inter-organizational collaboration in construction projects is a subject of industry discussion as well as of various initiatives and policies (Rigby, Courtney and Lowe, 2009). To facilitate implementation of collaborative contracting, often under the label of partnering, numerous guidelines have been issued and a rather standardized set of practices has emerged (Bresnen and Marshall, 2002, Nyström, 2005; Eriksson, 2010). Still, the general perception of the construction sector is that of an industry with low trust and high levels of conflict, and improving collaboration is often considered to require a cultural change. It has been questioned if this kind of more fundamental transformation can be brought about by a set of formal practices and systems (Bresnen and Marshall, 2002), and several authors have observed that partnering in practice often is more limited than the policies and guidelines envisage (Mason, 2007; Bygballe et al., 2010; Gadde and Dubois, 2010).

However, it may take time for organizations and individuals to adapt to and modify a new practice to a specific context, and partnering can be seen as an emergent practice (Bresnen, 2009). In this paper, we describe the forms that collaboration practice take in three recent and ongoing railway construction projects and analyse the causes of similarities and variations as well as implications for future development. We take an inside perspective, aiming to understand partnering related decisions from the perspective of the managers involved (Van Marrewijk et al., 2008), and view partnering practice as a learning process related to a management innovation: partnering mod-

els provide tools and techniques which project decision-makers interpret when they design and negotiate an approach suited to the specific project. The resulting practice will reflect the formal model, but also managers' own practice-based understandings and preferences regarding what collaboration implies and requires in terms of management and communication.

Frame of Reference

Research on diffusion of management innovations (Ansari et al., 2010) suggests that a practice that operates on an abstract level, has an interpretive viability and can lend itself to multiple interpretations has a greater likelihood of adaptation, albeit with greater variation and lower fidelity to the source model. Further, high divisibility, i e the degree to which an innovation may be experimented with at low cost (small trials), will facilitate adoption. Accordingly, adoption will be constrained if the innovation has a high complexity or is perceived as difficult to understand. Initially, a new practice may then be partially adopted in a simple low cost version, to be further adapted to the specific context and perhaps also more sophisticated and costly with time.

As stated above, partnering is generally associated with a set of tools, procedures and characteristics, although few partnering projects apply all of these (Nyström, 2005). Bresnen and Marshall (2002) mention selection procedures, formal teambuilding exercises, appropriate financial incentive systems, formal integrative mechanisms (such as charters, dispute resolution procedures, teambuilding workshops and the use of facilitators), continuous improvement programmes and benchmarking as being typical partnering tools and techniques.

Based on case studies of four Swedish projects, Eriksson (2010) recently compiled a list which is very similar to that of Bresnen and Marshall (2002). Thus, although partnering practices are likely to vary between countries, the core elements seem to be largely the same. Moreover, partnering is often described as a combination of highly defined practices and rather abstract notions such as "trust" and "collaboration" (Nyström, 2005). The latter are concepts that are parts of our everyday language as well as of a general social competence that most people feel familiar with. This combination of commonsense competencies and a relatively simple toolbox with high divisibility means that the threshold for applying partnering should be low, especially if there is a top management or government policy to legitimize collaboration.

Much research on construction partnering has focused on the problem of establishing trust between partners that have traditionally been more of opponents (Kadefors, 2004). Still, it is not only relationship building that requires communication and interaction, but the project activities per se. "Extra" partnering activities compete for resources with more directly instrumental project work such as design and construction, and there is often a need to balance between different goals (Huxham and Vangen, 2005; Enberg et al., 2006; Lawrence, 2006; Koppenjan et al., 2011). Thus, the apparent simplicity may mask difficulties and complexities that will arise as the reality of interparty collaboration unfolds.

In this paper, we shall focus on how the Swedish model for Increased Cooperation is applied in three cases. Below, we briefly outline the background to and elements of this model.

The Model of Increased Cooperation

In 2003 FIA, Förnyelse i anläggningsbranschen (Renewal in the Civil Engineering Industry), a forum for the infrastructure construction sector, was established by initiative of the former Swedish Road and Rail Administrations in collaboration with major engineering and contractor firms. The purpose of FIA is to encourage industry actors to jointly strive for renewal to achieve higher quality, lower costs and higher profits. Better incentives for research, development and learning within the industry are other important goals, as well as improving the image of the industry in order to attract future employees (www.fiasverige.se). As in many other countries, enhanced collaboration between industry actors has been suggested as an approach to raise efficiency and promote innovation. FIA presented a Swedish model for partnering called Increased Cooperation in 2004 (updated 2006), the name suggesting a type of collaboration that goes beyond that of traditional contracts (see Fig. 1). The term partnering is thus not used in this case. To date, this is the only larger Swedish policy initiative that is formally promoting collaborative contracting.

The model is intended to be applicable in all types of construction contracts used within the industry, although use of target cost contracts with a gainshare-painshare mechanism is recommended. There are three levels of cooperation, where the first level is compulsory for projects claiming to work according to the model. In the basic level, the following elements are included (English translation according to www.fiasverige.se):

Establishment of organization form
- An organization based on a steering group (partners' project sponsors) and cooperation group (executive managers)
- A process leader (external to project, responsible for IC aspects and activities)
- Workshops (meetings for dialogue concerning e.g. goals, work processes, cooperation, relations and communication).
- Leadership and top management support to change traditional attitudes and behaviour.

Joint management by objectives
- Formalized joint goals and plans for how to reach goals.

Joint risk management
- Risk management system according to other FIA guidelines.

Conflict-solving methods
- A routine for conflict management, where problems are initially discussed in the cooperation group and then in the steering group. Processing times at each stage are defined.

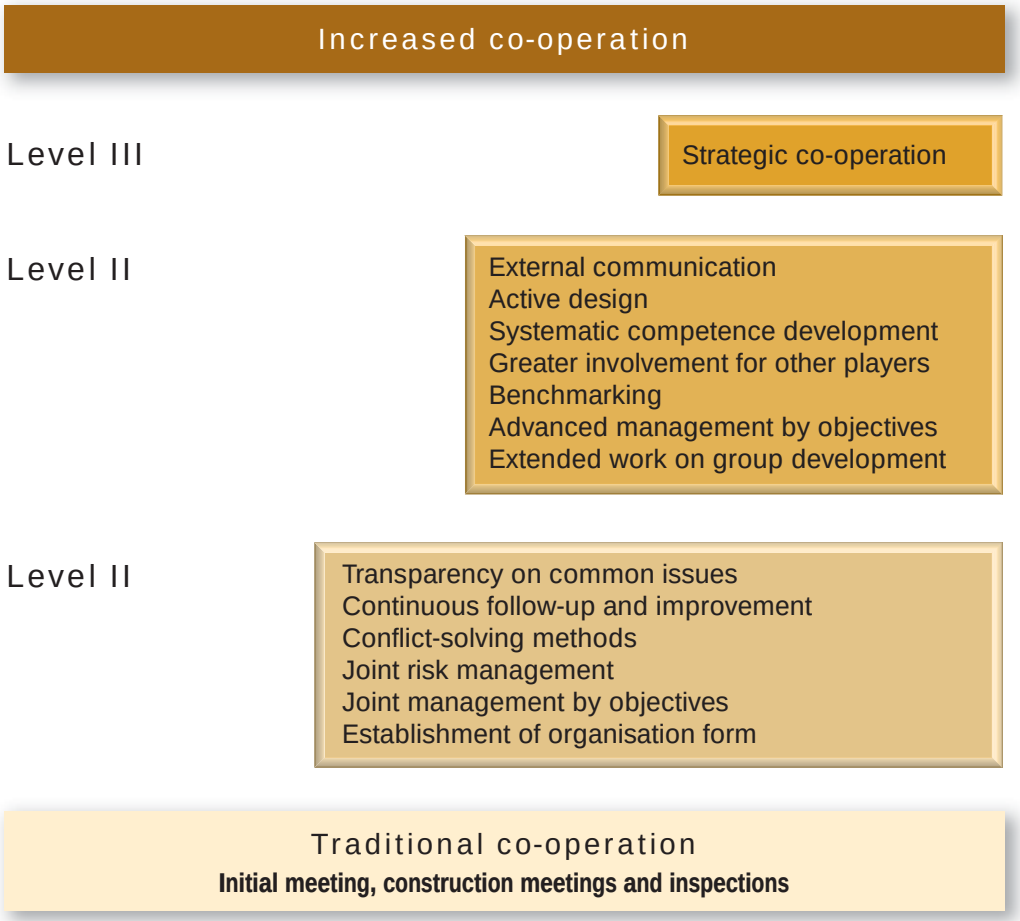

Figure 1. The model of Increased Cooperation. Source: www.fiasverige.se

Continuous follow-up and improvement
- Follow-up routines and measurements of improvements regarding common goals, plan of action, cooperation and working practice. Improvement actions and feedback to project participants.

Transparency regarding common issues
- It is a strong recommendation to use open book accounting.

Levels II and III
- In addition to the basic level, project may include also elements from level II. Level III implies a long term strategic cooperation, where several projects are bundled and procured together.

Comments

There are strong similarities between the systems and tools included in the IC model and those mentioned in the partnering literature. Apart from a section describing the components, the IC guideline includes both various general statements about the importance of changing attitudes and establishing trust, and advice regarding the pricing of construction contracts. Appendices include templates for texts which can be used in tendering documents and contracts for contractors and consultants. The guideline document is developed by a group of practitioners and academics and in terms of style and structure it is a mix of a research report and a handbook.

Method

Three rail construction contracts were selected for our case studies. One project (B) was in the middle of construction at the time of the study, while the two others were more recently started. In each project, representatives from the client (Swedish Transport Administration), contractors and consultants were interviewed (see Table 1). The interviews were semi-structured and lasted around one hour each. They were transcribed and statements sorted into themes.

The empirical questions addressed were: How is collaboration organized, which actors are included and which formal partnering processes and tools are used? Why did collaboration take this form and which are the experiences and problems encountered?

Project A

Contract: This contract included the new construction of all railway specifics, i.e. track, electric, signal and telecommunication works (TEST works), for a double track with the length of approximately 7 kilometers, constructed on the area of an existing up and running single track. The demolition of all current railway structures was also included, as well as the construction and demolition of temporary tracks to allow continuous traffic. The contract further involved developing the final construction documents for the temporary constructions in cooperation with

the client and designer. The TEST contractor also was responsible for coordinating four separate ground and bridge contracts. The contract sum was about 26 MEUR.

The pricing method for the contractor was a cost reimbursable contract with a fixed part and incentive, where the parties shared the profit or loss in relation to a target cost equally, and an open-book agreement. The contractor company had estimated a tentative target cost in their bid, but this was to be adjusted when the design for the temporary solutions had been completed. Regarding the change of target cost after this point, no formal criteria had been established at the time of the interviews. However, the parties agreed that the target cost should be changed when there were large changes from the original documents. The engineering consultant was procured on a reimbursable contract and had no incentive related to total project costs.

Cooperation Model: The compulsory level 1 of Increased Cooperation was applied between the client and the TEST contractor (but not the engineer). The four ground and bridge contracts were not included but had separate IC relationships with the client.

EC was initiated on the project level. Two related reasons for this choice were mentioned: that the client wanted the contractor to be involved in designing the temporary construction, which required a flexible pricing model, and that time was short for the project.

The collaboration group involved key personnel from the client and the TEST contractor with matching competences and levels: the project chiefs, the project managers and the foremen from both sides, approximately eight to ten participants. A start workshop was held for staff from the client and the TEST contractor. Values, expectations and goals for the project were discussed, but there was no explicit and formalized agreement on joint goals. No systems for performance evaluations, conflict resolution and risk management had been established, but there was an intention to develop such plans later. The agreement was to have collaboration group meetings when they "were needed", approximately once every quarter of a year.

The process leader of the collaboration work was a consultant who previously served as the client's project manager. There had been no training related to Increased Cooperation, and the client expected contractors and designers to educate their own staff in collaborative contracting. This also applied to the clients' organization, which mainly consisted of consultants hired for the project.

Although the interviewees thought that co-location of client and contractor project offices would have been valuable, they said that it would have been difficult to arrange facilities big enough for the total project organization for five contracts. Also, contractors worked on different geographical locations.

Views: The process leader tried to keep collaboration simple, and thought that it was important not to forget that parties have their different roles also in a collaborative project. He preferred to avoid formal performance evaluations in order not to threaten relationships, and emphasized informal mechanisms and evaluations performed in the cooperation group. The joint design meetings and other project meetings involving client, designer and contractor were perceived as very constructive and filling the function of cooperation meetings. The interviewees said that better integration between designer and contractor had led to improved knowledge sharing and also to fewer changes in the design. However, all parties believed that the engineering consultant should have been formally involved in the IC cooperation since design-construction integration was a major reason for choosing this model.

According to the client, the financial set-up was the most important element, since it was perceived to remove all conflicts of interests regarding compensation for changes. The view was that it would not have been possible to set a fixed price on this contract, and that the target cost contract had reduced both costs and conflicts substantially compared to a traditional fixed price contract. The contractor agreed about the advantages of the contract for the client, but added that it was very hard also to estimate a target cost for the contract. For the TEST contractor it was further a problem to have the coordination responsibility for the ground and bridge contracts without having any formal authority over the contractors that were to be coordinated. The TEST contractor would have liked all contractors to be involved in the same IC group with joint cooperation group meetings and joint goals for the entire project.

	Project A	**Project B**	**Project C**
Client	Project Manager, Process Leader	Ass.Project Manager	Ass. Project Manager
Contractor	Site Manager, Ass.Site Manager	Project Manager	Purchasing Manager
Consultant	Lead Engineer	Lead Engineer	Lead Engineer
Other		Process Leader	

Table 1. Interviews performed

Project B

Contract: In Project B, a railway yard in a larger city was refurbished and rebuilt from a cul-de-sac station into a run-through station. The construction time was 2 years and the project was completed in 2010. The contract included ground, track, electric, signal and telecommunication work. The contract sum was around 27 MEUR.

The pricing method for the contractor was a cost reimbursable contract with target cost and incentive, where the parties shared profit or loss in relation to a target cost equally. There were no fixed rules for target cost adjustments, but the target cost was changed when there were important changes and additions. The TEST contractor, which in this case was a subcontractor to the construction contractor, had the same pricing model. There were also bonuses related to schedule performance. The engineering consultant had a cost-reimbursable contract and no incentives related to project cost.

Cooperation model: Increased cooperation involved the client, the construction contractor and the engineering consultant (but not the TEST contractor). To choose IC was a central client initiative, due to complexity and temporary constructions.

There were two phases in the IC process. Initially, a large cooperation group was set up consisting of 15 individuals and with a process leader from the client. Workshops were large, sometimes involving up to 60 participants. According to the interviewees, this model did not work: since meetings lacked formal decision-making power people found them a waste of time. Thus, attitudes towards IC became negative. A new, external process leader from a management consultancy firm was engaged and a new group was formed involving only four people: the client's assistant project manager, the contractor's site manager, the lead engineer and the process leader. This way the collaboration group could make decisions and after some initial discussions and teambuilding assistance by the process leader this collaboration became successful.

The decided joint overall goals were "No serious injuries" and "No traffic disruptions", and specific goals were also set for each phase. These goals were measured, while relational aspects were only discussed more informally in the cooperation group meetings every third week. It was however seen as important to keep meeting contents and notes confidential to be able to talk openly about problems. Instead, a monthly newsletter was used to inform the whole project.

As in project A, no training about the IC model was offered. There was no formal conflict resolution model, issues were primarily resolved by the cooperation group and sometimes lifted to the steering group. The project was a pilot for a new risk management system, so this aspect was advanced. The contractor's management and the lead engineer were located at the client's project office, but not the design team.

Views: The small cooperation group and the co-location with common facilities for coffee and lunch were perceived as key success factors in the project, since this allowed for a lot of informal communication which increased mutual understanding and enabled people to efficiently solve smaller problems. Both the client and the contractor in retrospect thought that the engineering consultant's staff as well should have been located at the project office. The lead engineer agreed, but said that this would have required that the design engineers had been procured and involved to the project as individuals and not as anonymous resources providing consultancy hours, and that this would have be more expensive in terms of costs for travel and accommodation. The client thought that the number of involved consultants could then have been significantly reduced (from 130 to 10). The contractor stated that co-locating and contracting for individuals could result in over-sized organizations where people are locked up for long periods, which is good for the project but perhaps not for the companies involved.

Another opinion was that the contractor should have been contracted at the same time as engineer, since this would have reduced design changes. There were also some different opinions between the contractor and the engineer about the meaning of design collaboration, and the process leader thought that the parties should have spent more time analyzing and planning the project jointly before starting the joint design work.

Project C

Contract: The project studied concerned a part of a major underground commuter train tunnel in a big city. The contract comprises tunneling works and an underground station and the contract sum is around 130 MEUR. At the time of the interviews the project was in the early stages of the construction phase. The estimated construction time for project C is 9 years, to be finalized in 2017.

The pricing method for the contractor was a cost reimbursable contract with target cost and gainshare incentive. Below the target cost, the client and the contractor shared gains 60/40, while the client assumed all risk if the target cost was exceeded. There were also bonuses related to quality, collaboration ability and not disturbing residents in the area. The target cost was to be changed when there was a change in function and the cost exceeded 5000 EUR.

Cooperation model: IC involved the client, the construction contractor and the lead engineering consultant. To choose IC was a central client initiative early in the project. Also in this case, collaboration and pooling of competences were considered necessary due to the high complexity and technical difficulties. To transfer these risks to the contractor was not perceived feasible, since the risk premiums would have been too high and few if any contractors would have been willing to accept these risks at all.

The cooperation group consisted of members from the client, the contractor and the lead engineer. There were thoughts about involving subcontractors, but no specific plans. The process leader was a partnering specialist employed by the contractor but not involved in their project organization. Cooperation meetings were held every

or every other month. At the start workshop, 30 key employees from the client and the contractor attended, as well as the lead engineer. The joint goals decided at the workshop were to "strive for full bonus", "keep a good mood" and "keeping the ceiling high/be able to express opinions freely". The joint collaboration was evaluated every six months through an internet-based questionnaire system, owned by the contractor. Goals were also more informally evaluated at each cooperation group meeting.

Regarding conflict resolution there was a set time before unresolved issues would be brought up, first, to the cooperation group and, second, to the steering group. There was an ambitious joint risk management system which also included external actors, primarily the city and the local transportation service provider.

No IC training was provided, only broader information regarding the contract and economy. The contractor, however, has internal partnering courses. There were information events to the whole project every third month, and the contractor strived to involve workers and subcontractors in workshops. The lead engineer was located at the client's project office, but not the design team. The client site management was co-located with the contractor's site office.

The contractor was procured on the basis of design development documents, and the intention was to have contractor input in the design. However, the public planning and permission process was delayed and the large design team had to proceed with the detailed design despite that the procurement of contractors had to be postponed. The project planning and design organization was strongly tied to a highly structured document delivery plan involving design verification by the client and contractor, but it turned out that the contractor and client did not have sufficient resources to contribute fully to this process since they also had to plan and manage the construction activities. Design meetings were therefore held in 5 parallel sessions for different technical areas, so that the client and contractor could easily go between to give their input. Further, there were weekly meetings between the engineer and the contractor, where all problems related to design collaboration were discussed.

The lead engineer organized internal initiatives for the design team involving workshops and meetings discussing collaboration, and each design area had their own workshops. Some design sub-consultants were located at the office of the main engineering consultant.

Views: All parties saw collaboration as the only option for this project, and the interviewees were all very satisfied with the relational aspects. However, it was emphasized that collaboration, relationship building and communication need to be highly structured and formalized in a large and complex project of this type.

The client organization was composed both of internal client staff and external consultants, most of which had not worked together before. According to the contractor, the contractor team was already established when the project started, while the client project manager had to focus on getting his own group together and communicate collaboration values internally before relationships to the contractor team could be developed. This internal client team-building was successful, but took some time.

The engineer emphasized that feedback from construction to design is very important to improve design quality. He said that there is a lack of experienced engineering consultants, and that direct feedback is important to quickly educate younger staff. Thus, a more integrated way of working could benefit the whole industry and lead to better quality in future projects. He also thought that it is important that the documents are seen as a joint responsibility of the project and not only of the design team, but that there is a tendency that when construction starts, client and contractor attention shifts from design to site work.

The opinions of the collaboration were generally very favourable among those interviewed. In all three projects, collaborative contracting was perceived as the only way to handle high complexity.

Discussion

The opinions of the collaboration were generally very favourable among those interviewed. In all three projects, collaborative contracting was perceived as the only way to handle high complexity. Thus, the alternative to Increased Cooperation was not traditional contracts but contracts with high client risk without explicit relational goals and partnering processes.

Collaboration goals and perceived needs varied between the projects. In project A, the ambition was to improve flexibility with small means, primarily using the target cost contract. No formal evaluations were organized and the larger project was divided into smaller IC groups which could each cooperate more informally. The downside of this arrangement was that there was still uncertainty in coordinating between the five interdependent contracts. In the much more complex project C, extensive formalization and planning of both IC and design collaboration was seen as absolutely necessary to control the project. Communication between the subparts was carefully planned, and formal meetings and evaluations were important parts of the system. In project B, conflicts occurring in an initial approach with wider participation were solved by reducing organizational complexity and establishing strong trust within a smaller co-located core group. Here, formal evaluations were avoided but the external process leader was continuously involved.

Thus, Increased Cooperation took different forms in the projects and not all of the formally compulsory elements mentioned in the guidelines were used in all cases. The IC guideline seems to

have influenced mainly the organization forms (steering groups, cooperation groups, process leaders and conflict management systems). Workshops and target cost contracts were also used. Meeting frequency, follow-up workshops and evaluations, by contrast, varied much, as well as organizational complexity and involvement. Further, the guideline was not mentioned spontaneously and preparatory IC training had not been offered in any of the projects. Most likely, the guideline had been read by very few people in the projects, and the understanding of the IC concept, its fundamental building blocks and application in practice was probably built more on informal communication within the client organization and on peoples' general understanding of what collaboration and partnering implies. In effect, the project with the most elaborated collaboration (C) used the contractor's system and resources and not the IC model.

Our cases show that it can be applied with very varying levels of ambition regarding depth and width, and that the return on investment of a basic common sense approach can be high.

Practitioners seem to prefer informal collaboration in smaller groups to wider participation requiring more planning and formalization, and the positive views indicate that a simple approach may produce significant improvements. However, there were also tendencies that complexity was suppressed, primarily by limiting the number of participants and not installing formal relationship management and feedback, thereby potentially limiting performance. Still, the step to take from the informal and rather basic approach of project A to a more ambitious approach may be higher than practitioners think. For example, Project B illustrates the difficulties in organizing meaningful collaboration between a wide range of participants and meet their expectations of influence and efficiency. Further, all projects failed to fully anticipate the organizational prerequisites for successful design collaboration. In both A and B, the alignment between the collaboration goals and the way the engineering consultants were involved was perceived as insufficient. In A, the consultant was not part of the cooperation group; in B they were involved but not as individuals, and it was pointed out that a closer involvement could also have drawbacks. In C, the contractor was procured earlier and design collaboration was intended. Still, delays inhibited some of this collaboration, indicating that higher design/construction integration increases vulnerability and demands better control in earlier parts of the process. Also, while the design process was carefully planned not to delay production, client and contractor resources for design participation did not fully match this plan and the client organization itself was complex and needed time to integrate. Many of these problems probably reflect a client preoccupancy with preventing problems associated with traditional contracts, resulting in a focus on establishing trust and collaboration with contractors rather than on internal client relations and design management.

Conclusions

As a management innovation, partnering is clearly very flexible. Our cases show that it can be applied with very varying levels of ambition regarding depth and width, and that the return on investment of a basic common sense approach can be high. It is not surprising that managers prefer simple and informal approaches, and it is possible that the presence of low hanging fruits may prevent the spread of more sophisticated models except for in very complex projects. Still, many of those interviewed proposed further improvements, most often to include more participants and involve contractors earlier. Such seemingly insignificant changes may radically raise the needs for formalization and careful planning. A more complex collaboration including the design team, subcontractors or external actors requires not only more time and activities for relationship building but also that core project organizations and processes are designed and staffed to enable collaboration.

Thus, our case studies point to the importance of measures related to the practical organizing of cooperation. Available partnering tools and systems did not seem to be helpful in this respect, and participants were not very familiar with the model officially applied in the projects. Indeed, this model, as well as much partnering literature, tends to emphasize traditional attitudes, distrust and cultural change as main challenges, and do not deal much with the problems of managing instrumental project activities in a collaborative context. There is a clear risk that a preoccupation with emotionally "hot" issues implies a neglect of "cool" organizational aspects which are just as essential to both trust and performance, especially in complex settings.

In large infrastructure projects there is time for learning during the process. With a flexible pricing mechanism parties may develop their collaboration practice as their mutual experience increases. However, while the construction phase is long and parties often have had time to get to know each other before it starts, design collaboration is much more dependent on careful preparation upfront. Further, while in shorter projects project managers may improve their own direct collaboration competence from one project to the next, learning in the infrastructure sector often requires exchange of experience between project organizations. Such knowledge transfer is facilitated if the choice of organization and practices are underpinned by a comprehensive understanding of the totality of relational interaction and potential organizational alternatives. This learning aspect is another reason for clients to promote more sophisticated analyses in early project phases.

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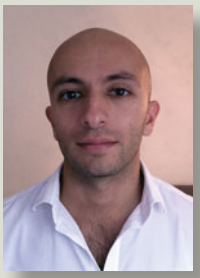

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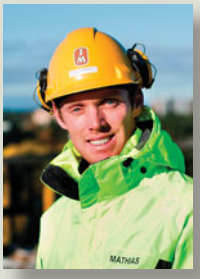

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Stakeholder Management in **International Projects**

International projects affect and are affected by multiple stakeholders with differing interests and demands. Consequently, understanding, and managing stakeholders' demands in the project decision making is of utmost importance in order to ensure the success of an international project. Despite the acknowledged importance of stakeholder management, project research still lacks both theoretical knowledge and empirical evidence concerning various project stakeholder related phenomena. This paper reports the key findings of a recent doctoral thesis. The objective of the thesis was to contribute to project research by increasing the understanding of external project stakeholder behavior and a focal project's stakeholder management activities in international projects.

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Introduction

Today's international projects are implemented in institutionally demanding environments and executed by coalitions of stakeholders that have differing interests, objectives and socio-cultural backgrounds. Consequently, the managerial challenges in international projects are not purely technical; these challenges also arguably entail the management of the social, political and cultural aspects in the context of several stakeholders with differing socio-cultural backgrounds, goals and strategies. As open systems, international projects are subject to the impacts of a wider socio-political environment and the demands and pressures stemming from external stakeholders such as community groups, local residents, landowners, environmentalists, regulatory agencies, and local and national governments. Such stakeholders are actors in the project's environment that are not formal members of the project coalition but may affect or be affected by the project. Consequently, understanding, and managing external stakeholders' demands in the project decision making is of utmost importance in order to ensure the success of an international project.

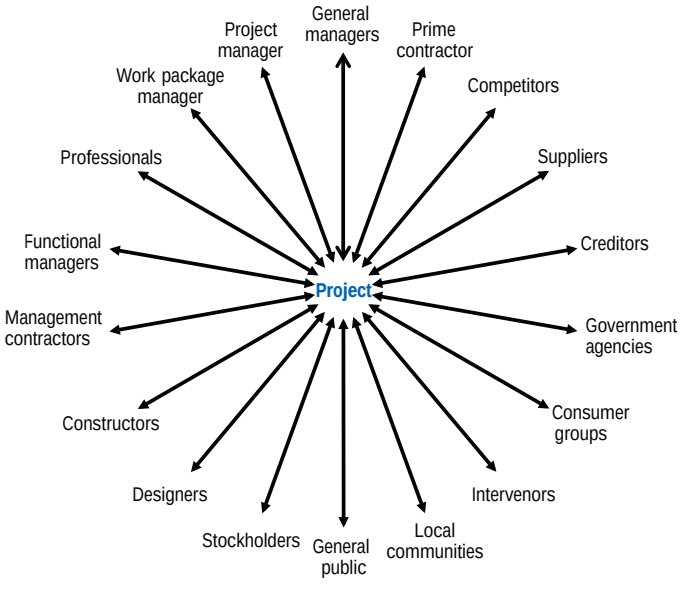

Figure 1. Project stakeholder model (Cleland, 1986)

In particular, a lack of understanding of the various interest groups, the drivers of their actions and their influence potential during the project lifecycle on the part of management, has been identified as a major challenge in international projects (IFC, 2007; Miller and Olleros, 2000). Even though some empirical studies have acknowledged the challenges and conflicts that have risen from the project's external stakeholder environment in international engineering projects (e.g. Flyvbjerg et al., 2003; Morris and Hough, 1987), the majority of the research has focused on the complex make-up of the project itself, ignoring the external stakeholder context of the project.

External stakeholders form a relevant part of the international project's environment that calls for firm managerial attention. The key objective of the thesis is to increase understanding of project stakeholder related phenomena through the study of how external stakeholders try to influence the project and how a focal project tries to manage these influences in international multi-firm projects. The research questions of the thesis have been addressed in five separate publications that are based on five separate case study research settings (Aaltonen et al, 2008; Aaltonen & Sivonen, 2009; Aaltonen and Kujala, 2010; Aaltonen et al, 2010; Aaltonen, 2011). These publications form a central part of the thesis.

The research questions of the thesis are:

- RQ1: What kinds of strategies do external stake-

holders use in order to shape their salience?
- RQ2: How do external project stakeholders take action and influence the project management's decision making during the different phases of the project lifecycle?
- RQ3: What kinds of strategies do focal projects enact as responses to the demands presented by external stakeholders?
- RQ4: How, through what kinds of practices, do project management teams analyze and interpret their external stakeholder environment in the context of international projects?
- RQ5: How are a focal project's local stakeholder relationships associated with the emergence and management of unexpected events in international projects?

Project Stakeholder Management

The management of project stakeholders is widely acknowledged as an essential part of project management and as a factor contributing to project success (Bourne and Walker, 2005). The notion of stakeholders was originally introduced to the mainstream general management discussion by Freeman (1984). Two years later, Cleland (1986) brought stakeholder thinking into the project management paradigm. Ever since, the role of stakeholder management as a central project management process has strengthened. The basic idea of stakeholder theory is that the organization has relationships with many constituent groups and that it can engender and maintain the support of these groups by considering and balancing their relevant interests (Freeman, 1984). Figure 1 presents the original project stakeholder model.

Various definitions and categorization attempts of stakeholders have been presented in the existing project management literature ranging from broad to narrow views. A common definition views stakeholders as individuals and organizations who may affect or be affected by the project. Stakeholders are typically divided into internal and external stakeholders. Internal stakeholders are the stakeholders who are formally members of the project coalition and, hence, usually support the project. External stakeholders are not formal members of the project coalition, but may affect or be affected by the project.

Project management literature presents also various methods and tools for the analysis and management of stakeholders. Existing stakeholder analysis models typically cover the following activities: identification of stakeholders, characterization and classification of stakeholders and decisions about which strategy to use to influence each stakeholder. As a result of stakeholder analysis,

Project stakeholder analysis process phase	Methods related to different stakeholder analysis process phases
Data collection concerning project stakeholders and their characteristics	- Face-to-face interviews (Varvasovszky and Brugha, 2000) - Snowball interview technique (Cova et al., 1996) - Generic stakeholder lists (Pouloudi and Whitley, 1997) - Brainstorming (Achterkamp and Vos, 2008; Calvert, 1995) - Surveys and semi-structured questionnaires (Cova et al., 1996; Karlsen, 2002) - Start up dialogue (IFC, 2007) - Delphi technique (Orndorff, 2005) - Lessons learned reports (El-Gohary et al., 2006) - Workshops, personal surveys, focus group discussions, public meetings, public hearings (El-Gohary et al., 2006)
Stakeholder identification and classification	- Cleland's model (1986): identify stakeholders and their interest, measure the interest, try to predict stakeholders' future behavior - Stakeholder salience model (Mitchell et al., 1997), classification based on power, legitimacy and urgency - Stakeholder group categorization (Winch, 2004): opponents and proponents - Power/interest matrix (Johnson and Scholes, 1999; Olander and Landin, 2005) - Vested interest-impact index (Bourne and Walker, 2005) - Stakeholder mapping (Winch and Bonke, 2002) - Role –based stakeholder models (Achterkamp and Vos, 2008; Vos and Achterkamp, 2006) - Outline tool (Andersen et al., 2004): area of interest, contributions, expectations, power, management strategy - Stakeholder commitment matrix (McElroy and Mills, 2003) - Stakeholder Circle, a tool for measuring and visualizing stakeholder influence (Bourne and Walker, 2006) - Stakeholder impact index (Olander, 2007) - Application of uncertainty management framework, SHAMPU (Ward and Chapman, 2008) - Stakeholder ethical responsibility matrix, SERM (Moodley et al., 2008)
Formulation of stakeholder management strategy based on the results of stakeholder identification and classification	- Communication and information dissemination strategies (PMI, 2008) - Stakeholder empowerment (Rowlinson and Cheung, 2008) - Stakeholder engagement process (Bourne and Walker, 2006; IFC, 2007) - Stakeholder involvement process (El-Gohary et al., 2006) - Keep satisfied, manage closely, monitor, keep informed (Olander and Landin, 2005)

Table 1. Stakeholder analysis models

project managers should be able to determine how to interact with and manage each stakeholder. Table 1 summarizes the majority of the conceptual research regarding project stakeholder management activities. It presents managerial tools and frameworks, related to stakeholder management, and links them with different stakeholder analysis process phases.

Despite the acknowledged importance of stakeholder management, project research still lacks both theoretical knowledge and empirical evidence of various project stakeholder related phenomena (Kolltveit et al., 2007; Achterkamp and Vos, 2008; Yang et al., 2009). Until today, existing scarce research has primarily focused on the conceptual development of stakeholder management tools and frameworks in order to better manage stakeholders. In these attempts, the ideas and theoretical frameworks of stakeholder theory have been utilized to a limited extent. Hence, what has been missing from prior literature is empirical research and theorizing on how stakeholders actually try to influence the project and how a focal project tries to manage these influences.

Research Process

The results of the thesis are based on five separate multiple case studies on international engineering projects that were conducted during 2007-2009. The results of the different studies were reported in five separate publications. The understandings of external stakeholder behavior, a focal project's managerial activities with regard to external stakeholders, and of the contextual factors that explain them, emerged through the process of conducting separate studies for each of the publications. The primary data for the individual studies were collected through semi-structured interviews and observations in project meetings. These primary data were complemented with company and project related documents and reports. For the study of the pulpmill case in Uruguay, available public data was used as the primary source of data. The data collection effort was part of the research project GPS II (Global Project Strategies II). During the research project, a total of 92 interviews on 21 case projects delivered to 17 countries were conducted. The majority of the raw interview data were utilized in the publications of this thesis.

Key Results

RQ1: Stakeholder influence strategies

Various scholars in the field of stakeholder research have pointed out that there is a need to understand the dynamic nature of stakeholder attributes and stakeholder influence strategies better. Mitchell et al. (1997) classify stakeholders according to their power, legitimacy and urgency of their claim and propose that these attributes can be used to define salience of stakeholder claims in order to determine, how much and which type of attention stakeholders receive from management. The study focused on identifying different strategies through which stakeholders attempt to increase their salience in the eyes of the project management and, thus, influence the progress and outcome of international projects. The empirical case of the study was a pulp mill project carried out in Uruguay. The plant, built on the banks of the border river between Uruguay and Argentina, was strongly opposed by different stakeholders in Argentina. The study identified different influence strategies that the external stakeholders used to affect their perceived power and legitimacy and this way the project implementation. Based on the empirical analysis of the pulp mill project, the paper identifies the following salience shaping strategies used by the opponent stakeholders: direct withholding strategy, indirect withholding strategy, resource building strategy, coalition building strategy, conflict escalation strategy, creditability building strategy, communication strategy and direct action strategy. The identified different influence strategies are presented in Table 2.

Type of stakeholder strategy	Description
Direct withholding strategy	Stakeholders restrict project's access to critical resources which are controlled by the stakeholder to increase their perceived power.
Indirect withholding strategy	Stakeholders influence project's access to resources that are not directly controlled by the specific stakeholder to increase their perceived power.
Resource building strategy	Stakeholders acquire and recruit critical and capable resources to their group to increase their perceived power.
Coalition building strategy	Stakeholders build alliances with other project stakeholders to increase their perceived power or legitimacy.
Conflict escalation strategy	Stakeholders attempt to escalate the conflict beyond initial project related causes (e.g. political). Through this process the project may become an arena for non project-related battles. This may introduce a new institutional environment in which stakeholders' claims are perceived as more legitimate.
Credibility building strategy	Stakeholders increase their perceived legitimacy by acquiring credible and capable resources, for example, capable individuals with good reputation or networks.
Communication strategy	Stakeholders use different types of media to communicate and increase the perceived legitimacy and urgency of their claims.
Direct action strategy	Stakeholders organize protests, road blockades, etc. to increase the perceived urgency of stakeholder claims.

Table 2. Stakeholders influence strategies

The findings of this study highlight the need to take into account external stakeholders in the stakeholder analysis, since, as the Botnia case demonstrates, stakeholder action can arguably increase the direct operational costs of projects in the form of legal fees and public relation expenses. A better understanding of external stakeholders' influence strategies increases project management's capabilities to manage stakeholders more effectively.

RQ2: A lifecycle perspective on stakeholder influence strategies

A project creates a dynamic context for stakeholder management because it moves through different phases during its lifecycle. Consequently, project stakeholders' potential to take action and influence the project management's decision making changes over the project lifecycle, as the project proceeds from the investment preparation phase through the project execution phase to the operations phase. The study develops propositions on the potential for secondary project stakeholders (stakeholders who do not have a formal relationship with the project) to influence the project management's decision making in the different phases of the project lifecycle. The propositions show how each project lifecycle phase has its own distinctive characteristics that have an effect both on the capability of secondary stakeholders to take action and use influence strategies, and on the project management's willingness to take into account different stakeholders' claims. The developed propositions are:

1. The salience of secondary stakeholders is highest during the investment preparation phase.
2. The higher the potential goal conflict between the project and the secondary stakeholders, the less salient the secondary stakeholders are during the investment preparation phase.
3. The likelihood of secondary stakeholders using influence strategies is low during the investment preparation phase.
4. The salience of secondary stakeholders decreases as the project proceeds from the investment preparation phase to the project execution phase.
5. The likelihood of secondary stakeholders using influence strategies is high during the project execution phase.
6. Secondary stakeholders are likely to employ influence strategies that increase their power attribute during the project execution phase.
7. Secondary stakeholders are likely to employ influence strategies that maintain the group's identity during the operations phase.
8. If there is a possibility of similar projects in the future, secondary stakeholders are more likely to continue the use of influence strategies.

The study reveals that particularly general project characteristics, such as the uniqueness of projects and irreversibility of decision making, influence both stakeholders' salience, i.e. how stakeholders' requests will be prioritized in the decision making processes, as well as stakeholders' capability to take action and use different influence strategies. From a managerial perspective, increased understanding of secondary stakeholders' attributes, concerns and behaviors in projects is needed, so that managers can better understand how to successfully engage secondary stakeholders into the project's decision making processes.

Furthermore, the findings of the study reveal an interesting paradox with regard to the optimal timing for including secondary stakeholders in the project's decision making processes. While from the project management's perspective secondary stakeholders are most salient during the investment preparation phase and, hence, have the best chances to influence the project management's decision making, in practice, due to the unique and temporary nature of projects, secondary stakeholders are most likely not able to use influence strategies during the early phase of the project lifecycle. In other words, at a stage where influence on project decision making is considered to be most acceptable from the project management's perspective, the potential for secondary stakeholders to voice their opinions is low. This mismatch of timing in the possibilities to influence and the capability to influence may result in conflict escalation during the project execution phase – a development that managers should not underestimate.

RQ3: Response strategies to stakeholder pressures

There is limited project stakeholder research that explores how stakeholder events are actually dealt with as they occur. Consequently, we only have little understanding of the diverse strategies that organizations involved in a project may use as a response to stakeholder pressures from the project's environment. In this study the focus is on strategies that the studied empirical projects have employed to respond to pressures exerted from their external stakeholder environment in the context of global projects. The identified response strategies range from passive to active approaches and are the following: adaptation strategy, compromising strategy, avoidance strategy, dismissal strategy and influence strategy. Their description is presented in Table 3.

The findings of the study show that a focal project may not be able to select from a wide range of response strategies but that there are different contextual factors that affect the choice. The findings of the study also bring up interesting observations with regard to the role of the project network in the enactment of different response strategies. The study suggests that the traditional view of the project stakeholder literature, which views stakeholder management from a single focal organization's point of view may be limited in the sense that it does not take into account the interactions among organizations within the project network. The results of the study show that the stakeholder management strategy actually emerges, is formed, defined and redefined in the interaction of the different actors taking active part in the project. In other words, the response strategy is not formed in the dyadic interaction between a focal project and a stakeholder or created by a central actor in the project network; rather, it grows from sequences of interaction and responses of multiple project network actors.

Type of response strategy	Description
Adaptation strategy	Obeying the demands and rules that are presented by stakeholders. It is considered that in order to cope with the demands and to achieve the objectives of the project it is better to adjust to the external stakeholder pressures.
Compromising strategy	Negotiating with the stakeholders, listening to their claims related to the project and offering possibilities and arenas for dialogues. Making reconciliations and offering compensation. Opening the project to the stakeholders.
Avoidance strategy	Loosening attachments to stakeholders and their claims in order to guard and shield oneself against the claims. Transferring the responsibility of responding to the claims to another actor in the project network. This kind of strategy resembles avoidance.
Dismissal strategy	Ignoring the presented demands of stakeholders. Not taking into account the stakeholder related pressures and their requirements in the project execution.
Influence strategy	Shaping proactively the values and demands of stakeholders. Sharing actively information and building relationship with stakeholders. Utilizing experiences from previous projects.

Table 3. Identified response strategies

RQ4: Stakeholder analysis and interpretation practices

An essential part of stakeholder management is stakeholder analysis. By conducting stakeholder analysis, project management teams attempt to build a "correct" picture of their stakeholder environment based on which organizational action concerning stakeholders can be determined. Building the "correct" picture of the project stakeholder environment, however, is not as straightforward as numerous normative managerial methods and tools of stakeholder analysis suggest (Olander and Landin, 2005). In this study the focus is on the processes through which project management teams read their external stakeholder environment. The theoretical point of departure for the study is Daft and Weick's (1984) typology about organizational interpretation modes that focuses on describing the process by which managers perceive, interpret and attempt to respond to changes in an organization's external environment. The study is built on the assumption that the process of stakeholder analysis is always an interpretation process that may produce different perceptions of the stakeholder environment. By adopting an environmental interpretation perspective, the paper describes the external stakeholder analysis processes in four international case projects that are implemented in challenging institutional environments. Based on the empirical analysis, four different types of interpretation modes that differ in their stakeholder analysis characteristics are identified. In particular, cross-case analysis reveals differences with regard to the project's level of activeness and regularity of carrying out the stakeholder analysis and interpretation processes, in addition to the degree of formality of the stakeholder analysis and interpretation processes. The results pertaining to the different interpretation modes implicate that projects may differ significantly in how they read and analyze their external stakeholder environment, ranging from environmental activeness to passive observation. By examining stakeholder analysis processes from an interpretation perspective, the paper offers new insight and understanding of the content and variations of project stakeholder analysis processes. Most importantly, the study opens up new avenues for understanding factors that are related to different ways that project management teams may perceive and interpret their stakeholder environment and, hence, questions the universalistic and rationalized view of the established stakeholder analysis guidelines. Accordingly, project managers should become aware of the central role that interpretation processes play in project stakeholder analysis.

RQ5: Unexpected stakeholder events and the role of local stakeholder relationship

International projects are increasingly carried out as networks of different organizations. As projects are embedded in complex stakeholder networks consisting of several organizations, it is essential to understand how these forces, external to the focal project organization, affect the project's behavior and structure (Engwall, 2003). Due to a focal project's interaction with local stakeholders with diverse socio-cultural backgrounds, projects are seldom implemented as planned; various unexpected events from the project's stakeholder environment may occur during project execution. More specifically, unforeseen and unanticipated influences from an international project's environment have been identified as one major source of uncertainty during the project implementation. The focus of the study was on how a focal project's patterns of relationships with local stakeholders are associated with the emergence and management of unexpected events in projects.

The results of the study demonstrate how a focal project's direct and indirect local stakeholder relationships are associated with the emergence and management of unexpected events in international projects. Due to differences in the amount and quality of local stakeholder relationships, the management, nature and number of encountered unexpected events differ from project to project. In terms of key findings, two types of unexpected events related to local stakeholder relationships are identified. First, the data reveals unexpected events that are due to misunderstandings and the

diverging practices, processes, values and norms of the focal project organization and the local stakeholders. Second, the study identifies unexpected events that emerged due to the challenges in the establishment of direct and indirect relationships with salient external local stakeholders, such as authorities or local residents on which the project's survival was dependent. These unexpected events were due to challenges in rooting and anchoring the project in its institutional environment. Consequently, the findings paradoxically reveal that both the existence and the lack of local stakeholder relationships to salient actors may generate unexpected events in international projects. Therefore, when designing the structure of the project network, managers should take into account both the need to engage local stakeholders to the project network in order to anchor the project to its institutional environment and the need to create an integrated and cohesive project network that is capable for co-operation Additionally, the study provides guidance for managerial practice. First, the findings provide new insight especially into unexpected events triggered by the local stakeholders and into the role of local stakeholder relationships in the management of unexpected events. The results of the study show how local actors may be engaged directly in managing unexpected situations and how local stakeholders may be actively used as a source of local knowledge. Therefore, the findings of the study highlight the necessity of managers to pay attention to the configuration of the stakeholder network and its association with unexpected events in international projects. Second, by introducing a stakeholder network perspective and considering also indirect local stakeholder influences, the study challenges the traditional view of an individual project organization interacting with an individual stakeholder, which is strongly present in the current project stakeholder management models. Therefore, managers should go beyond dyadic direct stakeholder relationships, and when possible, also map potential indirect stakeholder influences by analyzing the stakeholder networks of their stakeholders. Overall, the differences observed in the project's interaction with its environment due to different local stakeholder relationship settings call for project management approaches that are adjusted to the focal project's degree of embeddedness in the local stakeholder network.

Conclusions

Overall, the findings of the thesis highlight the importance of external stakeholder management in international projects. Through the application of the ideas of stakeholder theory, the results of the thesis provide new theoretical and empirical understanding of how external project stakeholders may influence the project management's decision making during the project lifecycle. Furthermore, the results demonstrate how a focal project may analyze its external stakeholder environment and respond to external stakeholder pressures and unexpected events in the context of international projects. Ultimately, the new knowledge of external stakeholders' influence strategies and better understanding of how a focal project can deal with stakeholder influences, supports project managers in the development of effective project stakeholder management approaches. The bi-lateral focus on (1) external stakeholders' interests and strategies and (2) project managers' interpretative orientation toward stakeholders and their subsequent responses, rarely seen in the literature, creates a deeper understanding of how stakeholders and project managers interact. From a practical perspective, the findings highlight the strategic role of project stakeholder management. It is suggested that project-based firms should pay attention to their instructions concerning project stakeholder management processes – oftentimes a separate stakeholder management process does not exist, but superficial analysis regarding stakeholders is conducted as a part of project risk analysis processes. In addition to the focus on internal and technical project issues, project managers should be trained and informed about the need to take an active role in the management of the external influences from the project's environment.

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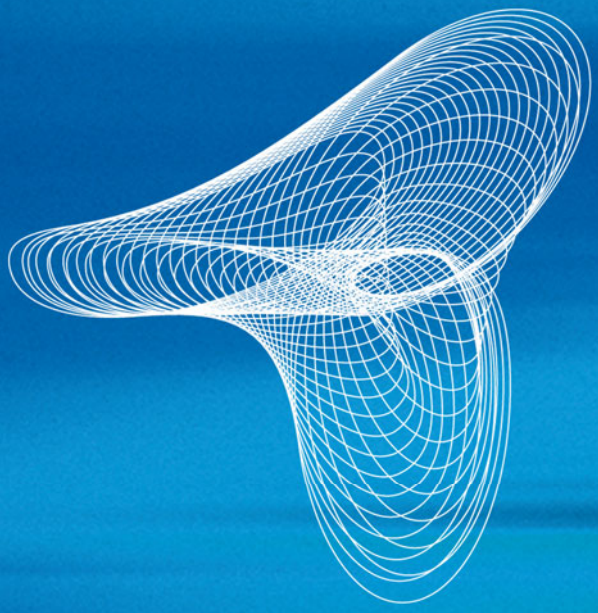

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